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RETINAL TUMORS IN TUBEROUS SCLEROSIS

REVIEW OF THE LITERATURE AND REPORT OF A CASE, WITH SPECIAL ATTENTION TO MICROSCOPIC STRUCTURE

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Involvement of the retina in cases of tuberous sclerosis escaped notice until 1921, when van der Hoeve,[1] of Amsterdam, Netherlands, published a clinical report describing six cases of tuberous sclerosis in which tumors of the retina were observed through the ophthalmoscope. Since then a number of clinical reports of this condition have appeared, indicating that such retinal tumors are not uncommon and that disturbance of vision and the ophthalmoscopic examination may give the first clue as to the disease.

The case presented here is the sixth in which microscopic study of the retinal tumor is described and the first to be reported in this country in which such a study was made.

REVIEW OF THE LITERATURE

The term tuberous sclerosis, or tuberose sclerosis, was first used by Bourneville, who, in a series of articles published from 1880 to 1898, described a rare form of cerebral sclerosis observed at autopsy in young persons who had shown during life mental deficiency and epilepsy. He noticed in some the coexistence of tumors of the kidney of a primitive, mixed cell histologic character. He also noted the coexistence of adenoma sebaceum, which had previously been described as a hyperplasia of certain elements of the skin distributed in butterfly fashion on the face and often associated with epilepsy and poor mentality.

1. van der Hoeve, J.: Augengeschwülste bei der tuberösen Hirnsklerose (Bourneville), Arch. f. Ophth. **105**:880-898, 1921.

Largely from the work of Vogt in 1908,[2] the clinical syndrome of mental deficiency, epilepsy and adenoma sebaceum was established, and several series of cases of this condition were published. Adenoma sebaceum may be described as a nodular reddish rash distributed in a butterfly-shaped area over the nose and cheeks. It was soon recognized that the cerebral condition might exist without one or even any of the classic clinical signs. It is also evident that cases of this condition may be brought to clinical notice as instances of tumors of the kidney, heart disease or, because of the disfiguring cutaneous lesions, adenoma sebaceum. This is so because multiple tumors of mixed, undifferentiated cells may be present in the heart, kidney, spleen and other organs, of which it is now known that the eye is one.

Epiloia has been used by psychiatrists to denote the complete syndrome of mental defects, epilepsy and adenoma sebaceum.

The term tuberous sclerosis may be used to include also any combination of aggregations of multiple tumors of this type, although it really describes only that feature which is most constant, multiple tumors of the cortex of the brain.

A family history of developmental defects and psychopathic trends is common, and the disease becomes manifest during the first two decades of life. It is a heredofamilial disease.

Van der Hoeve [1] first described the occurrence of flat tumors in the retina of each eye in six cases, in one of which there was a tumor of the optic disk bulging forward into the vitreous. Others have reported such tumors, but in a much smaller proportion of cases. Critchley and Earl [3] found them in only one of their twenty-nine cases.

They are described as oval or circular white or gray areas in the retina, away from the disk, the average diameter being about one-half that of the disk. Only exceptionally are they in close relation to the blood vessels, and there is no surrounding tissue reaction. There are also in some cases larger nodular tumors, extending into the vitreous, usually at or near the disk. In one of van der Hoeve's [1] cases and in cases reported by M. Nitsch,[4] E. Kuchenmeister,[5] Bau-Prussakakowa [6]

2. Vogt, H.: Zur Pathologie und pathologischen Anatomie der verschiedenen Idiotieformen: II. Tuberöse Sklerose, Monatschr. f. Psychiat. u. Neurol. **24**:106-150, 1908.

3. Critchley, M., and Earl, C. J. C.: Tuberose Sclerosis and Allied Conditions, Brain **55**:311-346 (Sept.) 1932.

4. Nitsch, M.: Augenhintersgrundsbefund bei tuberöser Hirnsklerose, Ztschr. f. Augenh. **62**:73-75, 1927.

5. Kuchenmeister, E.: Ueber einen Fall von Pringlescher Krankheit mit Veränderungen am Augenhintergrund und an den Schleimhäuten von Blase und Mastdarm, Dermat. Wchnschr. **99**:133-137, 1934.

6. Bau-Prussakakowa, S.: Ueber einen Fall von tuberöser Hirnsklerose mit Netzhautveränderungen und benignem Verlauf, Ztschr. f. d. ges. Neurol. u. Psychiat. **145**:275-282, 1933.

and F. Rintelen [7] such tumors of the disk are described. G. Salom [8] reported the ocular findings for twenty-nine persons in five families, in each of which there was at least one case of well defined tuberous sclerosis. He listed four types of retinal changes: (1) yellowish red spots; (2) blurred pigmented spots; (3) nevoid spots and nevi, clearly outlined, and (4) pigmented changes identical with those of pigmented retinitis. Probably only the first of these represents tumor. Von Herrenschwand [9] reported a case in which there were tumors near the margins of each papilla, describing one of them as resembling a "mulberry composed of glittering white nodules." A. Vogt [10] described a retinal tumor resembling a mulberry. Overbosch [11] reported a case in which there were "bilateral typical tumors of the fundus oculi." Guillain and

Accepted Cases of Retinal Tumors in Tuberous Sclerosis

Author	Year	Number of Cases	Tumor of the Disk	Pathologic Study Made
van der Hoeve [1]	1921	6	1 case	2 cases
Schob [15]	1925	1	No	Yes
Overbosch [11]	1926	1	No	No
Nitsch [4]	1927	1	Yes	No
von Herrenschwand [9]	1929	1	No	No
Feriz [16]	1930	1	No	Yes
Salom [8]	1932	5 (2 doubtful)	No	No
Critchley and Earl [3]	1932	1	No	No
Bau-Prussakakowa [6]	1933	1	Yes	No
Kuchenmeister [5]	1934	1	Yes	Yes(1935)
Guillain and Lagrange [12]	1934	1	No	No
Vogt [10]	1934	1	No	No
Gottlieb, J. S., and Lavine, G. R.: Arch. Neurol. & Psychiat. **33**: 379-388 (Feb.) 1935	1935	1	No	No
Rintelen [7]	1935	1	Yes	No
Storchhein, F., and Taube, E. L.: Am. J. Ophth. **19**: 508-509 (June) 1936	1936	1	No	No
Total		24	5	5

Lagrange [12] described a case in which there were choked disk in each eye and, in one eye, the white spots typical of van der Hoeve's "phakomatosis."

7. Rintelen, F.: Fundusveränderungen bei tuberöser Hirnsklerose, Ztschr. f. Augenh. **88**:15-19 (Dec.) 1935.

8. Salom, G.: Contributo allo studio sulla familiaritá della sclerosi tuberosa, Rassegna di studi psichiat. **2**:945-960, 1932.

9. von Herrenschwand, F.: Ueber Augenhintergrundveränderungen bei tuberöser Hirnsklerose, Klin. Monatsbl. f. Augenh. **83**:732-736, 1929.

10. Vogt, A.: Seltener Maulbeertumor der Retina bei tuberöser Hirnsklerose, 9 Jahreverfolgt, Ztschr. f. Augenh. **84**:18, 1934.

11. Overbosch, J. F. A.: Vertooning van een patient met tubereuse sclerosis, Nederl. tijdschr. v. geneesk. **2**:2632-2635, 1926.

12. Guillain, G., and Lagrange, H.: Phacomatose rétinienne de Van der Hoeve dans un cas de sclérose tubéreuse, Bull. et mém. Soc. méd. d. hôp. de Paris **50**: 1421-1425 (Nov. 12) 1934.

In tuberous sclerosis, besides the typical, multiple small tumors in the cortex of the brain, there are usually tumors projecting more or less into the ventricles; it is these which sometimes cause choked disk. Nystagmus, strabismus and myopia have rarely been found.

From the descriptions in some of the cases of tuberous sclerosis reported it is difficult to say exactly how many patients have shown retinal tumors, but we have found twenty-four cases in which we think they were present.

The description of van der Hoeve [1] remains as the pattern for an investigation of a case of this condition.

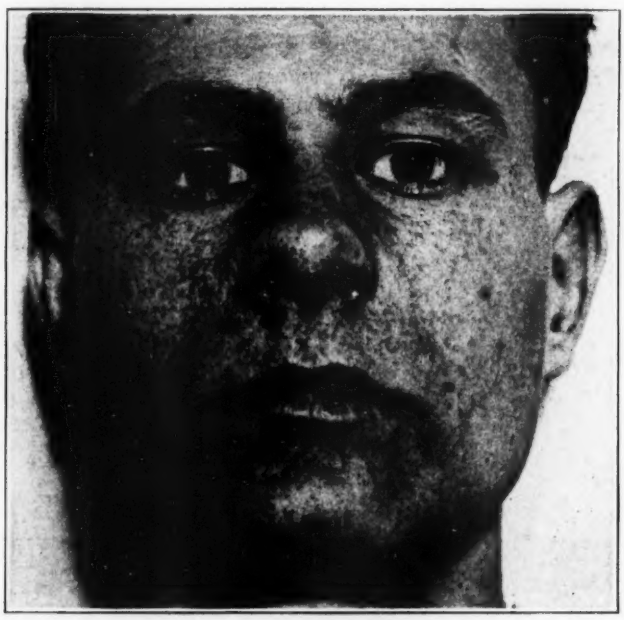

Fig. 1.—Appearance of the patient in 1931, after he had received ten treatments (coagulation) on the left side of the face and nose. The typical appearance of adenoma sebaceum is still seen on the right.

REPORT OF CASE

An Italian man aged 20 was admitted to the neurologic service of the Rhode Island Hospital under the care of Dr. William N. Hughes on March 17, 1935, because of frequent, severe convulsive attacks.

At the age of 4 years he began to have mild convulsive seizures, which were infrequent until about two years before admission to the hospital, since when they had increased in frequency and severity. At the age of 14 he was seen by Dr. F. Ronchese, of Providence, R. I., because of a nodular eruption on his face. A diagnosis of adenoma sebaceum was made and was confirmed by biopsy. The urine, the blood count and the blood chemistry were normal. The Wassermann reaction was negative. Psychometric tests showed the patient to be four years

retarded. He was presented at the Atlantic Dermatological Conference, held in Boston on Nov. 10, 1930, and the case was reported in print in 1931.[13]

Two weeks before admission, after three months in which there were no attacks, he had a very severe attack, followed by two others. On the day before admission he had fourteen.

He was found to have bronchopneumonia. On March 18 he was free from convulsions and appeared normal mentally. An extensive neurologic examination gave negative results except for weakness of the lower part of the right side of the face. He did not appear mentally defective. On both sides of the neck were some small pigmented, fibrous cutaneous tumors.

The right pupil was larger than the left; both reacted to light. Vision in the right eye was reduced to counting of fingers at 2 feet (60 cm.). Vision in the left eye was nearly normal. There was no gross refractive error. The right disk was obscured by a white, shiny mass with a nodular surface, which extended forward 5 diopters, overlying the vessels.

On the next day the patient had many convulsions and died.

On later investigation the patient's father was found to have adenoma sebaceum of the face (proved by biopsy) and to suffer from peculiar attacks which were not typically epileptic. Ophthalmoscopic examination of his eyes revealed no retinal tumors.

PATHOLOGIC FEATURES

In 1923 van der Hoeve [14] published a pathologic study of the retinal tumors from two of his six patients. From one he had only a single eye, which was enucleated because of a suspicion of malignant change. In this eye there were a large tumor of the optic disk, which he regarded as the primary growth, and several smaller secondary tumors scattered over the retina. In the second case both eyes were removed at autopsy. There were no tumors of the papilla, but there were several retinal tumors in each eye. The histologic picture in the two cases were essentially alike. He described the tumors as being made up of nerve fibers and a peculiar kind of cell. He expressed the belief that the fibers came from the nerve fiber layer and extended through holes in the membrana limitans interna into the overlying tumor. The cells were described as having much cytoplasm, which in places fused with that of neighboring cells to form a syncytium. The nucleus was usually large, with a prominent nucleolus. In the papillary tumor there was a large incrustation. In all the tumors there were spaces without any special lining, filled with blood and serum. Blood vessels were sparse. The tumors appeared to originate in the nerve fiber layer and frequently extended to involve the ganglion cell layer but seldom any others. On the surface of the large tumor of the optic disk were button-like projections which, he believed, became pinched off, to float in the humor, and then became

13. Ronchese, F.: Nevus Fibro-Angiomatosus (Adenoma Sebaceum Pringle), Arch. Dermat. & Syph. **23**:793 (April) 1931.

14. van der Hoeve, J.: Augengeschwülste bei der tuberösen Hirnsklerose (Bourneville) und verwandten Krankheiten, Arch. f. Ophth. **111**:1-16, 1923.

implanted elsewhere on the retina. Indeed, he actually observed this to occur, through the ophthalmoscope.

We have been able to find only three additional reports of pathologic studies of these tumors—all in German.

In 1925 Schob [15] published his observations on the eyes of a 6 year old child who died of tuberous sclerosis. There were no tumors of the disk. Grossly, small, whitish, slightly raised areas could be seen on each retina. Microscopically, some were flat and some sharply raised. He described buds and daughter buds with constricted necks, on the surface of the larger tumors. In his case the tumors were limited to the nerve fiber layer. He, too, described fibers but concluded that they were definitely glial fibers and not nerve fibers. He, too, described a syncytium, and giant cells with two or three nuclei. The nuclei were large and vesicular, with little chromatin and with from one to three nucleoli. They were oval, long, curved and sometimes dumb-bell shaped.

In 1930 Feriz [16] reported a histologic study of a solitary tumor of the left eye which did not involve the disk. This tumor involved the nerve fiber layer and the ganglion cell layer. He described large "spider and star-shaped" cells. The cytoplasm stained strongly eosinophilic. In places the walls of the cells were indistinct, suggesting a syncytium. Many cells contained vacuoles. The nuclei were round to three cornered. There were bands and whorls of fibers which he considered "neuroglia-like."

The third such study was by Kuchenmeister [17] in 1935. Both eyes were involved. The optic disks were not involved. Unlike the observations in previous reports, all the layers were invaded. In places there was calcification, and in the choroid there was some bone formation. The cells varied in size and shape. There were "new-formed glial fibers."

At postmortem examination in our case, typical lesions of tuberous sclerosis were seen, including multiple tumors of the brain, rhabdomyoma of the heart, lipofibromas of the kidneys and adenoma sebaceum of the Pringle type. In the right eye was a single raised, whitish tumor 3 mm. in diameter, which covered the upper and inner two thirds of the optic disk.

Histologic preparations showed the tumor overlying the optic disk and, as in Kuchenmeister's case, involving all the layers of the retina. It also invaded a portion of the optic nerve. In the central portion of

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15. Schob, F.: Beitrag zur Kenntnis der Netzhauttumoren bei tuberöser Sklerose, Ztschr. f. d. ges. Neurol. u. Psychiat. **95**:731-740, 1925.

16. Feriz, Hans: Ein Beitrag zur Histopathologie der tuberösen Sklerose, Virchows Arch. f. path. Anat. **278**:690, 1930.

17. Kuchenmeister, E., cited by Fleischer: Ueber klinischen und anatomischen Befund bei tuberöser Hirnsklerose, Ztschr. f. Augenh. **88**:158 (Jan.) 1935.

the tumor was a large, irregular mass of ossification, and about this were calcium-containing concretions. Van der Hoeve mentioned a "large incrustation," and Kuchenmeister mentioned "calcification and bone formation." The surface of the tumor was smooth; there were no buds, as were described by van der Hoeve and Schob. At the periphery of the tumor a thin layer of tumor cells extended out over the surface of the external limiting membrane.

Fig. 2.—Low power photomicrograph of a section through the nerve head, showing the location and extent of the tumor. The ossification in the center of the tumor is prominent. The thin dark line on the surface of the retina peripheral to the main tumor is an extension of tumor cells.

The cells varied greatly in size and shape. Some were almost round. Others were markedly angulated. The boundaries of the cells were often indistinct, suggesting a syncytium. Many cells were elongated, and the cytoplasm was drawn out to a thick process.

The nuclei were round or oval and vesicular. A single nucleolus was frequently prominent. Multinucleated cells were seen, having from two to five nuclei.

We were at first unable to demonstrate any production of glia fibrils, but in preparations stained for us with phosphotungstic acid by Dr. J. G. Greenfield, of the National Hospital for Nervous Diseases, London, there could be seen short, fine fibrils in the processes of the larger cells.

The type of cell was not definitely determined. Van der Hoeve [14] suggested that these large cells are descendants of the first anlage of the retina and that they are neurocytes which have not differentiated

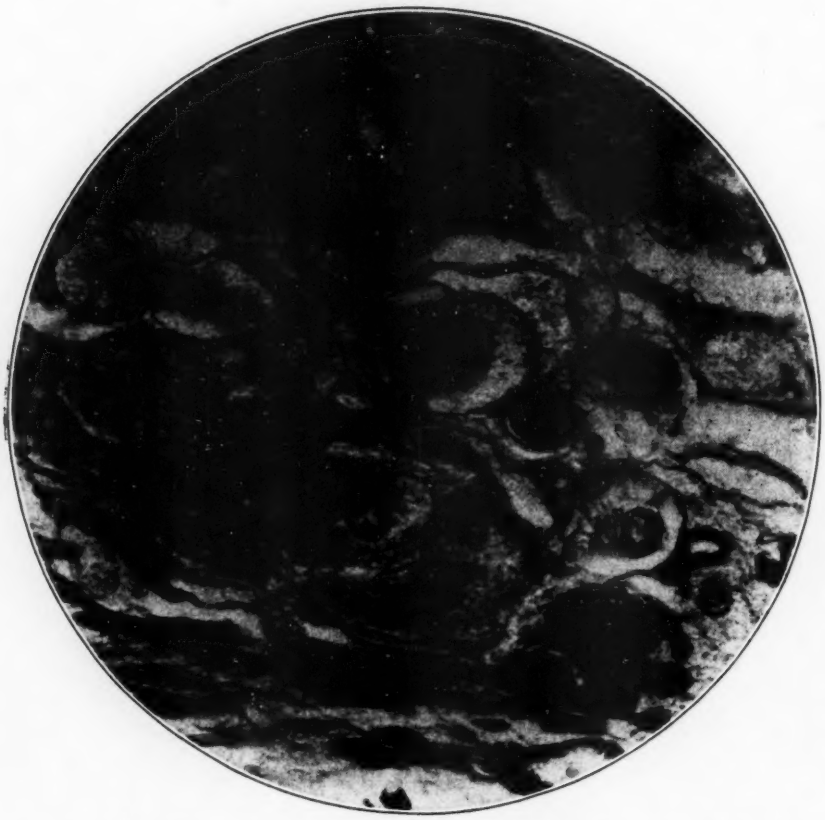

Fig. 3.—High power photomicrograph of tumor cells, showing variation in size and shape, vacuolation and the tendency to form a syncytium.

into glia or ganglion cells or "glia-neurocytes." In the belief that they arise from embryonic cell rests, he proposed that they be called "phakomata," from the Greek word *phakos,* meaning mother-spot. Combining these words, he arrived at the term "neurocyto-phakomata retinae or papillae."

Schob [15] concluded that these tumors are closely related to other gliomatous tumors and that they take origin from the nerve fiber layer, which normally contains glia cells. He proposed no definite name.

Feriz [16] considered these tumors much like those seen in the brain and expressed the belief that they are made up of atypical neuroglia-like tissue.

Because of our ignorance concerning the embryology of the eye, we sought the help of Miss Ida Mann, of London, England, whom we quote:

With regard to the derivation of the cells, I think, as they are glial, one will have to postulate their descent from the first stage (from the fourth to the fifth

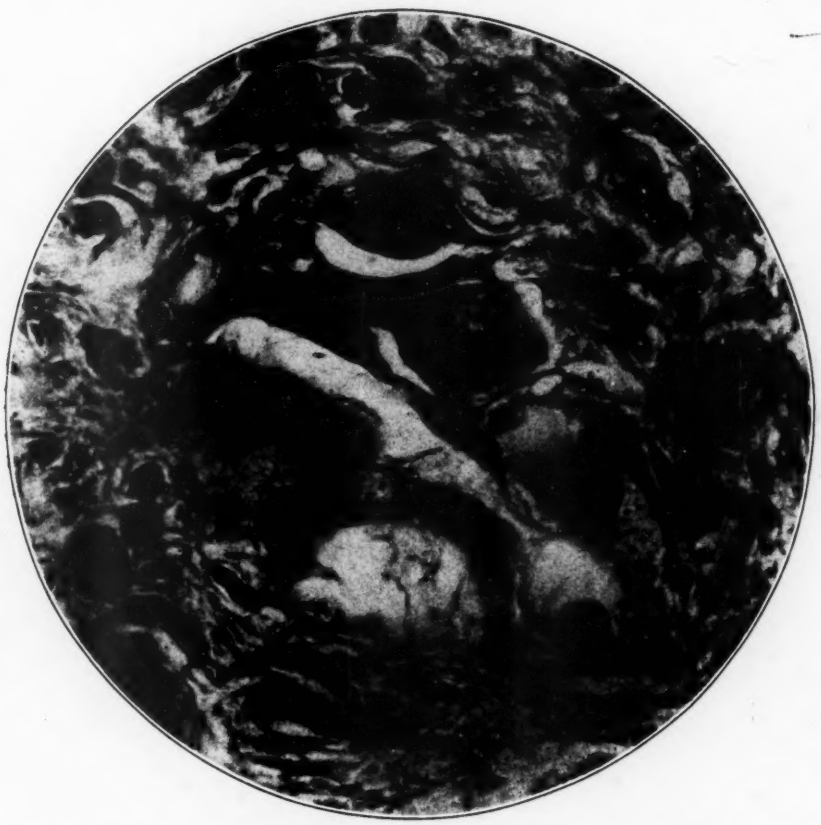

Fig. 4.—A group of tumor cells with blunt protoplasmic projections suggesting nerve cells, and a multinucleated syncytial mass. The rounded black masses are calcium-containing concretions.

week) of retinal differentiation, when the cells destined to form supporting structures are separating from the primitive neuro-epithelium. I should consider that the cells in your tumor . . . have begun to differentiate into the specialized glia of the retina, but have not got very far. . . . There are also in your tumor some cells in which fibrils cannot be seen. These may be neurocytes, but if they are they are probably derived from the inner neuroblastic layer, since these cells begin at the same time as the müllerian fibers. I should say that the tumor arose during stage 2 of retinal differentiation (from the sixth week to the third

month) from glia cells of the inner neuroblastic layer, with possibly a few undifferentiated ganglion and amacrine cells included. The fact that it is on the disk need not cause confusion, since the primitive epithelial papilla, before it is replaced by nerve fibers, is well known to be able to differentiate into abortive retina. The fact that the tumor is on the disk is itself in favor of its having arisen about the 15 mm. stage to the 20 mm. stage. If it had arisen earlier, the fetal fissure would have been open, and one would expect its closure to have been interfered with by the tumor at its upper end and some sort of coloboma of the disk to have resulted. If, on the other hand, it had arisen later, after nerve fibers had replaced

Fig. 5.—Section showing a few fibrils within the cytoplasm of some cells; Mallory's phosphotungstic acid-hematoxylin stain.

the neuro-epithelial cells (at the 25 mm. stage and after) it would be difficult to see where its cells of origin came from, since Bergmeister's papilla is definitely glial by then, and dedifferentiation of cells, once finished, is hardly to be postulated in this case.

It seems evident that these tumors must arise from some early cell of the embryonic retina. It appears definite that glia fibers were present in the cases of Schob, Feriz and Kuchenmeister. None were present

in van der Hoeve's case. Van der Hoeve described nerve fibers which were not seen in any other case.

Grinker [18] suggested that "these tumors are probably astroblastic neoplasms of low growth possibilities but as yet enough has not been reported to be sure of classification."

It seems, from a review of the descriptions in the literature, from the observation in our case and from a consideration of the embryology, that these growths are largely made up of glia cells. Together with the lesions in the brain and other organs, they probably should be considered as hamartomas rather than true tumors.

SUMMARY

Twenty-four instances of retinal tumor in cases of tuberous sclerosis are collected from the literature. In only four of the studies reported was a pathologic examination made. We have added a fifth such study, the first to be recorded in this country. The case reported by us is the sixth in which there was a tumor of the optic disk. We feel that cytologic evidence, together with the embryologic possibilities, justifies the conclusion that these tumors are essentially gliomatous.

We think it probable that if psychiatrists, ophthalmologists and pathologists have this lesion in mind the incidence will prove to be much greater than the meager literature suggests.

18. Grinker, Roy R., in Penfield, Wilder: Cytology and Cellular Pathology of the Nervous System, New York, Paul B. Hoeber, Inc., 1932, p. 1058.

SECONDARY CATARACT

WITH PARTICULAR REFERENCE TO TRANSPARENT GLOBULAR BODIES

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Transparent globular bodies frequently constitute an interesting feature of after-cataract. A few of the many bodies of this nature observed by us, as seen with the slit lamp and the corneal microscope, are illustrated in figures 1, 2, 3, 4, 5 and 6.

Little has been written about this peculiar and frequently occurring phenomenon, although J. Hirschberg [1] remarked on "drops" which not only form a part of various cataracts but are found in after-cataract membranes. Elschnig [2] described them exactly and made microscopic examinations. He failed to mention Hirschberg.

Koby [3] stated that transparent globules are found more frequently in the young than in the old and that he rarely met with globular cells after the fiftieth year. This has not been our experience. There seems to be no preference in regard to age. Of the four cases of after-cataract with formation of globules described by Vogt,[4] three were those of patients aged 62, 63 and 64 years, respectively.

The globules are seen only after division of the capsule of the lens, never after all the remains of the capsule have been removed. Visual

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Read before the American Academy of Ophthalmology and Otolaryngology, New York, Oct. 1, 1936.

From the Department of Ophthalmology, University of Pennsylvania, and the Laboratory of Ophthalmology, Wills Hospital.

1. Hirschberg, J.: Einführung in die Augenheilkunde, Leipzig, Georg Thieme, 1901, p. 159; quoted by Vogt, A.: Lehrbuch und Atlas der Spaltlampenmikroskopie des lebenden Auges, Berlin, Julius Springer, 1931, p. 634.

2. Elschnig, A.: Klinisch-anatomischer Beitrag zur Kenntnis des Nachstares, Klin. Monatsbl. f. Augenh. **49**:444, 1911.

3. Koby, F.: Slit-Lamp Microscopy of the Living Eye, ed. 2, translated by Charles Goulden and Clara Lomas Harris, Philadelphia, P. Blakiston's Son & Co., 1925, p. 282.

4. Vogt, A.: Lehrbuch und Atlas der Spaltlampenmikroskopie des lebenden Auges, Berlin, Julius Springer, 1931, pp. 716, 717 and 719, figs. 1450 *a*, *b* and *c* and 1459 *b*, *c* and *d*.

acuity is affected, depending on the extent of the occupation of the pupillary area by the globules. They vary in size up to 2 mm. in diameter (fig. 1) and are similar in appearance and action to perfectly transparent soap bubbles. Sometimes one or more can be seen hanging

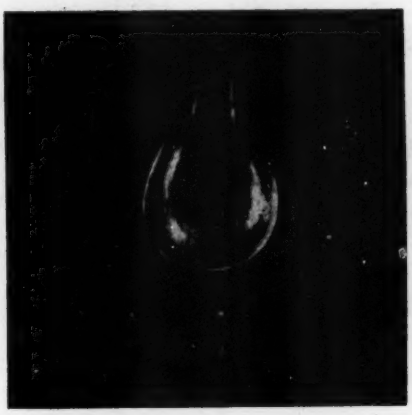


Fig. 1.—Transparent globular body seen in the eye of Mrs. F. K., aged 65, who had diabetes and arteriosclerosis. The drawing was made eight days after extraction of the lens. Six weeks later the large globule could not be seen, but there was a bunch of small globules in the upper pupillary space. These continued to change until the last time the patient was seen, thirty-two months after the operation.

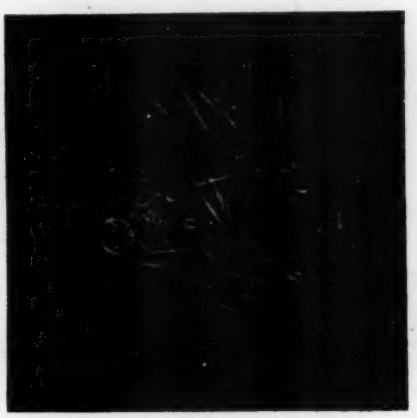
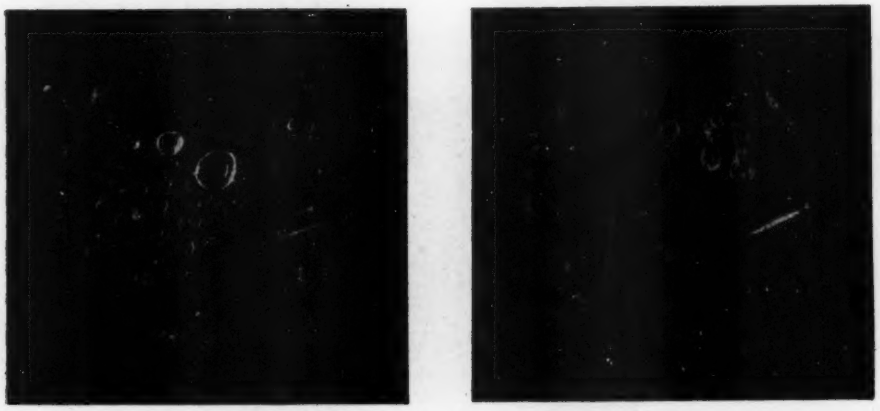


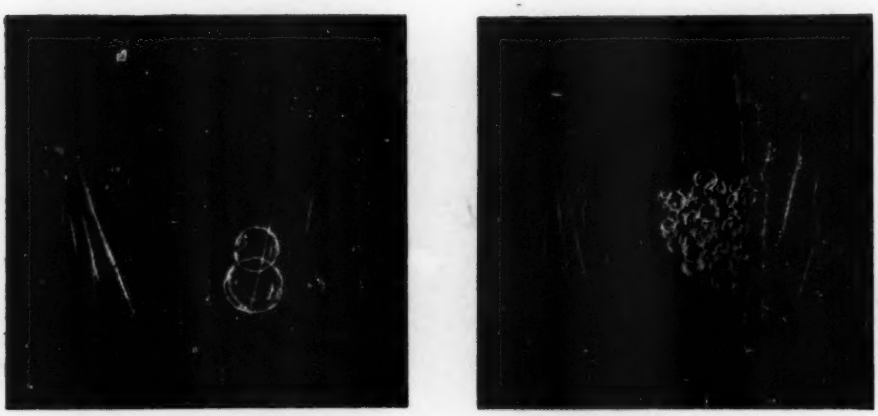
Fig. 2.—Transparent globular bodies seen in the eye of Miss S. H., aged 25. The drawing was made two years after discission for congenital cataract.

by a thin pedicle, but mostly they occur in bunches. When the globules are very small, the mass appears like foam or froth. Not infrequently we have seen the whole pupil filled with them.



A B

Fig. 3.—*A*, transparent globular bodies seen in the eye of Mrs. E. M., aged 58. The drawing was made two years after combined extraction of senile cataract. There was hernia of the vitreous below the lower edge of the remaining portion of the capsule. Vision was 6/20 with correction. The condition continually changed. *B*, appearance of the same eye two years later; the condition was still changing.



A B

Fig. 4.—*A*, transparent globular bodies seen in the eye of J. D., aged 8. The drawing was made seventy days after linear extraction and iridectomy for traumatic cataract. Ten days previously only one globule was seen. *B*, appearance of the same eye one month later. The globules had increased in number, and four months after operation the pupil was entirely filled with them.

Whether a single globule or a large number are seen, they always extend from a portion of the remaining part of the capsule of the lens. Some are spherical; others are ellipsoid. Often they fluctuate with the movements of the eye. They change continually in appearance.

Fig. 5.—Transparent globular bodies seen in the eye of Mrs. M., aged 63. The drawing was made two years after combined operation for senile cataract. When the patient was seen three months later, the large globule had disappeared.

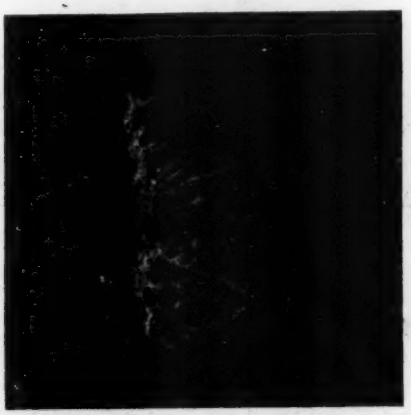


Fig. 6.—Transparent globular bodies seen in the eye of A. B., aged 11, eight days after unsuccessful discission for congenital dislocated cataract. The knife needle merely nicked the capsule of the lens, at which place the bunch of globules grew.

From time to time the picture differs. In a surprisingly short time some globules disappear and new ones appear. They are produced rapidly, are seen a few days after operation and continue to form, vanish and form again, the process continuing for years. One is given the impression that they blow up and finally burst like a toy balloon. Sometimes, when the process is arrested, the wall of the globule gradually loses its transparency.

While the exact nature of these bodies is not understood and while they are seen more frequently after operation, they may occur after any separation of the capsule, as in the case (fig. 6) in which they were produced after a knife prick of the capsule. Vogt [5] has seen them develop in the interior of the lens after contusion.

In one instance, that of a woman 58 years of age, the whole pupillary space was filled with a layer of these globules. The entire membrane was removed by the method of Lyster.[6] The microscopic appearance is illustrated in figures 7 to 11, inclusive. The gross specimen consisted of a small, irregularly quadrilateral grayish membrane. After fixation in a 10 per cent dilution of solution of formaldehyde U. S. P., it was transferred to a 70 per cent solution of alcohol and examined under glass with the slit lamp. When examined in vivo this tissue had

Fig. 7.—Section through the membrane of the secondary cataract, showing the anterior capsule of the lens and proliferated capsular epithelium.

exhibited innumerable small glistening rounded globules, but after fixation the greater number of these could not be seen. There was, however, near one margin of the material a small area in which there were still a few globules. These globules were small but were typical of those seen in the eye previous to extraction of the secondary membrane. Therefore, it was considered advisable to section this membrane serially.

A typical section of the membrane formed an arc of tissue about 6 mm. in length, consisting chiefly of the posterior capsule of the lens in the middle portion and the equatorial and the anterior capsule

5. Vogt,[4] fig. 1330.

6. Lyster, Theodore C.: Management of Dense Secondary Cataract, Am. J. Ophth. **16**:122 (Feb.) 1933.

of the lens at each end. In many of the sections the anterior capsule was folded inward, and there was included in the space so formed a number of degenerated lens fibers. The posterior capsule of the lens was thin and presented no noteworthy features except that in several

Fig. 8.—Fold of the anterior capsule of the lens, within which are seen large bladder cells and proliferated capsular epithelium with adjacent, interlacing hyaline bands.

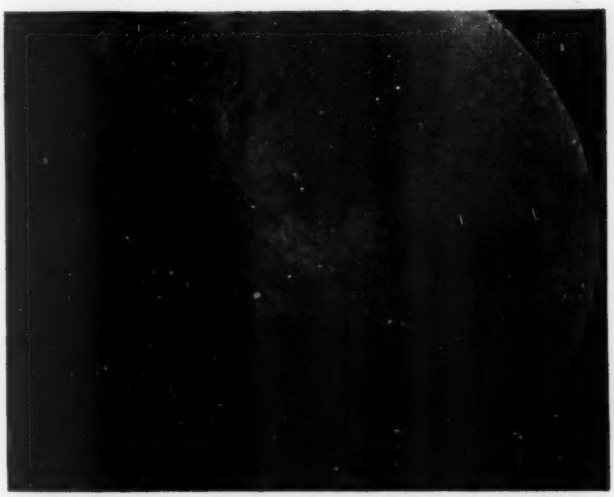


Fig. 9.—Proliferated capsular epithelium with loops of apparently newly formed capsular tissue.

sections there was a longitudinal split and in others the anterior capsule, which was moderately thick, showed capsular epithelial cells on both sides. This appearance must have resulted from proliferation of the

capsular epithelium around the torn edge of the anterior capsule. At times these cells exhibited marked changes. The cell wall was circular; the cytoplasm had disappeared, except for a few granules, and the nucleus either was flattened against the wall or was entirely absent. At other points there was marked proliferation of capsular epithelium, so

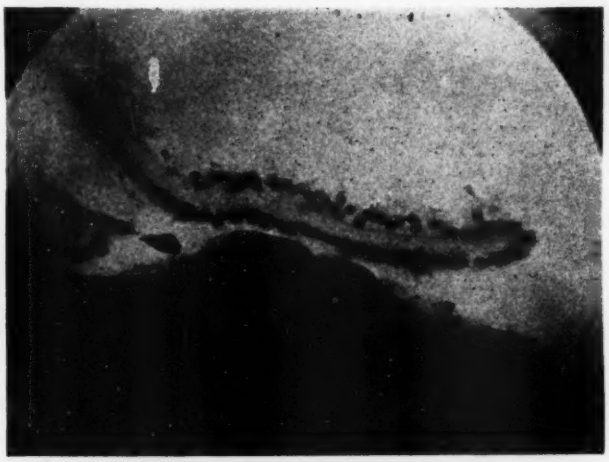


Fig. 10.—Capsular epithelium which had proliferated to cover both sides of the anterior capsule.

Fig. 11.—Two vesicle-like capsular epithelial cells. They appear different from bladder cells.

that the cells were four or five layers in depth. In the places in which there were such layers of epithelial cells they were not piled on top of one another but were separated by loose interlacing bands of hyalin-like tissue similar to that of lens capsule. These hyalin-like bands

were in a position to be the product of an abnormal activity of the epithelial cells. In some places cross-sections of lens fibers had the appearance of large, irregularly rounded spaces filled with a fine

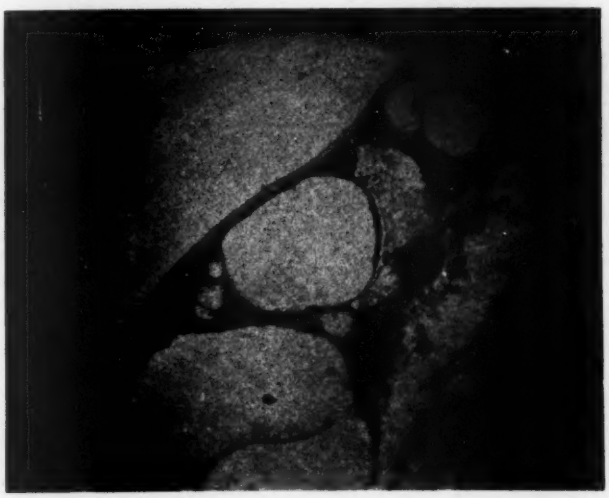


Fig. 12.—Vacuoles within a lens dislocated into the vitreous. The capsule of the lens was intact.

Fig. 13.—Vesicle-like formations beneath the capsule of a lens dislocated into the vitreous.

granular deposit—the so-called bladder cells. There were no spheres of Morgagni. No calcareous areas were noted, and no slits which might have contained cholesterol crystals were present.

The three features which are pertinent to the present discussion are: first, the vesicular or bladder cells; second, the interlacing bands of hyaline tissue, and, third, the cystic appearance of a certain number of the proliferated and swollen capsular epithelial cells. The bladder cells

Fig. 14.—Group of vesicles on the surface of a degenerated retina.

Fig. 15.—Group of vesicles, apparently derived from cells on the surface of a degenerated retina.

probably do not account for the appearance of the globules described by Hirschberg and by Elschnig. These cells commonly are found within and should be seen in most cataractous lenses. But no such formations were noted in the cases which we observed. Concerning the second feature, the interlacing hyaline bands, these had a folded appearance at

places that suggested collapsed vesicles, but it seems unlikely that they could account for the delicate walled structures under consideration. It seems most likely, therefore, that the globules of Hirschberg and Elschnig are formed from cystically enlarged capsular epithelial cells.

Clinically, it had been found that the occurrence of these globules on membranes of secondary cataract was so frequent that it was thought advisable to examine sections of enucleated eyes containing secondary cataracts in order to determine whether any structures other than those found in our specimen could account for the formations seen by the slit lamp. Accordingly, a number of specimens from the collection of pathologic material at the University of Pennsylvania and at the Wills Hospital were examined. No additional information was obtained from this search.

Fig. 16.—Vesicle on the surface of a degenerated retina, in which a flattened nucleus is visible, indicating the cellular origin of the vesicle.

The formation by intra-ocular cells of a large thin-walled vesicle-like structure is not limited to the capsular epithelium of a secondary cataract. Such a vesicle-like structure was seen in a lens dislocated within the vitreous but otherwise intact. The capsular epithelium of this lens showed that it was abnormal to a certain extent, in that it had proliferated so as to line the whole posterior capsule. This structure is seen in figures 12 and 13. It is also known that similar processes occur in cells on the surface of degenerated retinas, as shown in figures 14 and 15. The cellular derivation of such a vesicle is clearly indicated in figure 16, in which a flattened nucleus is still visible.

It is noteworthy that in the observations described by Elschnig the histologic examinations were made on the eyes of two patients.

In the report of neither case is there an accompanying description of the results of clinical or slit lamp examination. The histologic changes were essentially those of a secondary membranous cataract with a well marked Soemmering ring. The hemispherical nodules which he described were solid formations, part of which contained nuclei and part of which did not. He stated that the red-stained ones were without a nucleus. This indicates to us that they had undergone greater degeneration. He did not distinguish these sharply from the well known bladder cells.

A SKETCH OF THE EARLY DAYS OF OPHTHALMOLOGY IN PHILADELPHIA

BURTON CHANCE, M.D.
PHILADELPHIA

Ophthalmology—the first of the medical specialties—owes much to the practitioners of Philadelphia. It took many years, however, before in this city the "specialty" reached a status sufficiently secure to receive the dignified support of the medical profession, as well as the respect of the community, enabling it to go on and on to maintain, nationally and internationally, its place in the science of medicine.

Until after the middle of the eighteenth century in this country, just as in England and on the Continent, diseased eyes were treated by itinerant quacks, or by those who, by self-teaching, from their own experience or from what they had learned somewhere in Europe acquired more or less skilful ability to relieve sufferers from ocular disease. Such persons were known as "oculists," to be regarded with suspicion and aversion by the regular physicians, both in this country and in England, so that until about the second quarter of the nineteenth century the title oculist was one of opprobrium.

Nevertheless, here and there certain systematically educated surgeons deliberately undertook to treat ocular conditions. They operated for squint and for cataract, incised abscesses of the lacrimal sac and attempted the repair of eyelids torn and distorted in consequence of wounds received in warfare and from accidents in the early industries. Soon after the University of Pennsylvania School of Medicine began to graduate students, young physicians sought further education in London, Edinburgh, Paris and Vienna. Their nebulous knowledge of the anatomy of the orbit and its contents became more exact, and after returning to America they confidently and deliberately cared for a greater variety of disorders.

Certain practitioners, fortified by the increased knowledge gained by their experience in the Revolutionary army and with greater understanding of their problems, entered into civil practice after the war; yet, a "medical man" in those days was compelled to be all things to all men—surgeon, physician, obstetrician and nurse. Preeminent in

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Read in abstract before the Section on Medical History of the College of Physicians of Philadelphia, Oct. 12, 1936, and in full before the Section on Ophthalmology, November 19.

Philadelphia at the end of the eighteenth century and in the first quarter of the nineteenth was Philip Syng Physick, deferentially spoken of as "the father of American surgery." He was distinguished for his operation on the crystalline lens and famous as an "extractor of cataract." Another pioneer in ophthalmology was Gibson, who devised an operation on the straight muscles of the eye for the correction of squint.

Dr. Physick, a native of Philadelphia, after finishing his course in arts at the University of Pennsylvania, became the student of Dr. Adam Kuhn, with whom he continued until 1788. Then he went to London,

PHILIP SYNG PHYSICK M.D.

Fig. 1.—Philip Syng Physick in early years.

where he so attracted John Hunter that he was invited to become a member of that great master's household. Through Hunter's influence Physick secured a position on the house staff of St. George's Hospital, where he was afforded many opportunities to acquire extensive surgical proficiency. After a few months with Hunter he went to Edinburgh to graduate in medicine at the university of Edinburgh, which for many years was the source of American medical education. He returned to America in 1792, being then only 24 years of age, and began practice

in Philadelphia, which he conducted with distinction for forty years, throughout which time numerous cases of ocular disorders came under his observation. He was appointed surgeon to the Pennsylvania Hospital in 1794 and served in this capacity for many years. Some of his pathologic specimens preserved in the museum are still in good condition, and when certain of them were studied in recent years the diagnoses originally entered were confirmed by the histologic observations. Physick wrote little, and his records are scanty; yet he kept

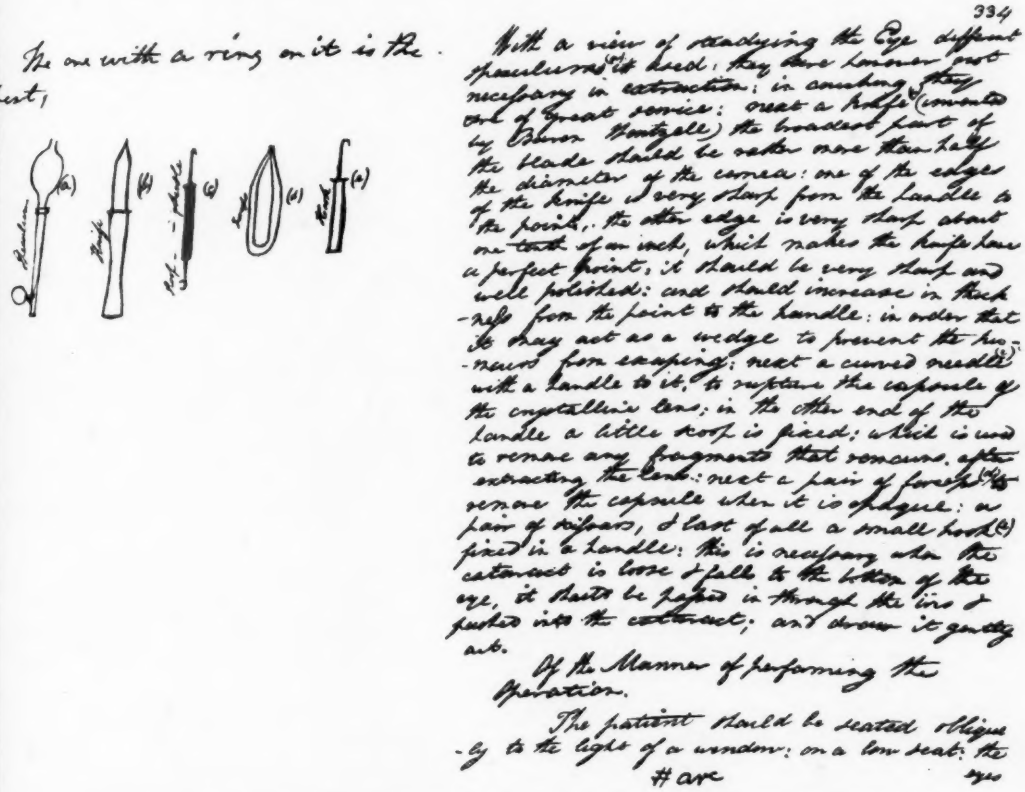


Fig. 2.—Two pages from "Notes on Surgery," taken from the lectures of Philip Syng Physick, M.D., professor of surgery in the University of Pennsylvania, by William Elmer, a student in medicine, during the winters of 1808, 1809 and 1810. The notebook is in the library of Dr. Walter G. Elmer, of Philadelphia.

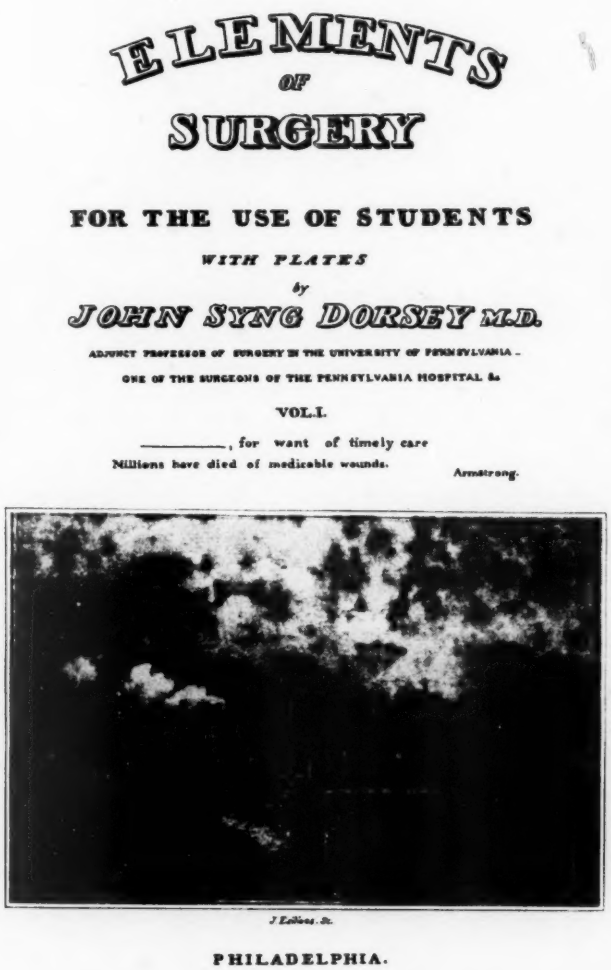
a private journal of his interesting cases. The first recorded relates to the blindness of a woman which he relieved by the extraction of the opaque lens. Couching was the usual operation of that day, but Physick had discarded that method because of defects inherent in it. Instead, he adopted the method of Baron Wenzel, and was highly successful in using it. Wenzel, as is known, incised the cornea at the upper limbus with

a long blade, the edges of which sloped, forming an isosceles triangle. The blade, as it passed across the expanse of the aqueous chamber, plugged the incision, preventing extrusion of the iris and thus made a clean wound through which the unbroken lens could pass. No iridectomy was done. The capsule was lacerated with a hooklike point, and the lens was withdrawn with another hook—a true extraction. Although Physick succeeded well in the wider fields of surgery, it is likely that

Fig. 3.—John Syng Dorsey.

his popular fame rested not a little on his skill in ophthalmic surgery. It is of interest to note that the last operation he performed, which took place in the midsummer of 1837 (when he was in feeble health), was on the eye. He was famous as a teacher, and his favorite nephew, Dr. John Syng Dorsey, who assisted him, endeavored to carry out and

continue his methods, thus extending Physick's teachings, which he compiled in his "Elements of Surgery." This served as a surgical text-book for many years. But this admirable association was terminated by the untimely death of Dr. Dorsey in 1818, at the age of 35 years.



ELEMENTS
OF
SURGERY

FOR THE USE OF STUDENTS

WITH PLATES

by

JOHN SYNG DORSEY M.D.

ADJUNCT PROFESSOR OF SURGERY IN THE UNIVERSITY OF PENNSYLVANIA &c
ONE OF THE SURGEONS OF THE PENNSYLVANIA HOSPITAL &c

VOL. I.

———, for want of timely care
Millions have died of medicable wounds. Armstrong.

J. Lallicat. Sc.

PHILADELPHIA.

Published by Edward Parker & Kimber & Conrad

Fig. 4.—Title page of Dorsey's "Elements of Surgery."

Physick's manner as a teacher and clinician must have been impressive. The University of Pennsylvania possesses several manuscript volumes of notes made by his students and assistants. His courses were entirely clinical and covered all subjects relating to the surgery of his day. I had the great privilege of seeing the notes made by a Dr. Elmer in three years about 1810. The chapters on diseases of the eye are

extensive and give with unusual detail Physick's treatment of cataract. The notes of Elmer are explicit in all details. In that day, smallpox having played its devastating part, there were many cases of occluded pupils and leukomatous corneas. Physick had much success in his efforts to form an artificial pupil, for which he invented forceps with a punchlike beak with which to perforate the membrane of the iris.

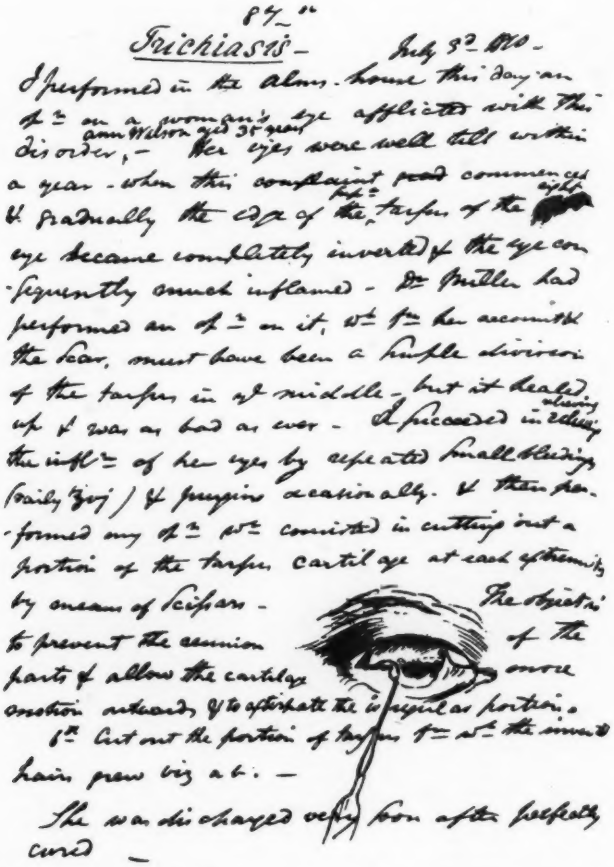


Fig. 5.—A page from "Notes from Medical and Surgical Cases" taken from 1801 to 1811 by John Syng Dorsey. The notes shown were taken in 1810.

William Gibson, too, another graduate of the University of Pennsylvania, was especially interested in diseases of the eye. He has been credited with being the first in America to operate for convergent strabismus. His procedure, which he described in 1818, antedated that by Dieffenbach by many years. He began practice in Baltimore, and on the retirement of Physick was called in 1819 to succeed Physick at the University of Pennsylvania, a position which he held until 1855.

Gibson wrote a textbook entitled "The Institutes and Practice of Surgery," published in 1824, in the second volume of which he presented in the successive eight editions a résumé of the state of ophthalmic practice as it existed in the first and second quarters of the nineteenth century. Gibson dedicated his textbook to Physick, and from it most American surgeons secured their basic education in surgery during a

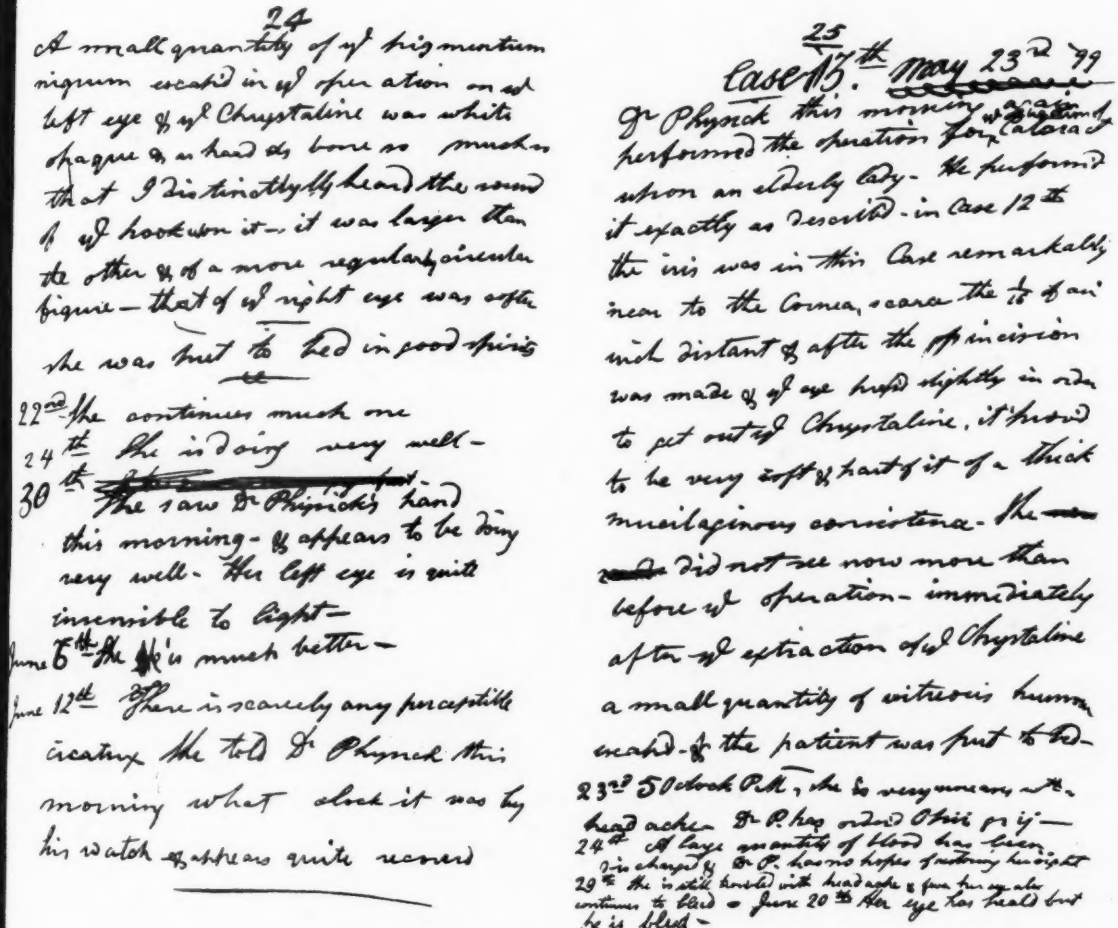
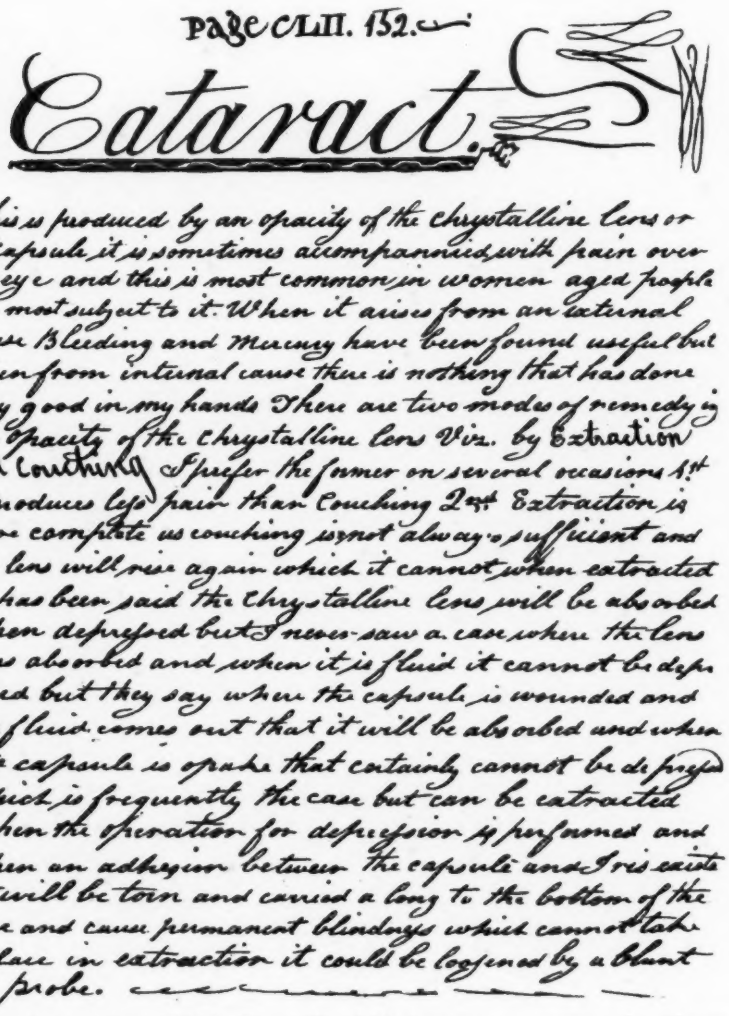


Fig. 6.—Two pages from "Notes from Cases in Surgery" (these cases were observed in the practice of Dr. Physick), taken by John Syng Dorsey in 1798-1799.

period of thirty years. Gibson continued to be prominent in American ophthalmology for many years, doing much toward the successful treatment of cataract, having perfected a linear extraction as early as 1811; yet one seldom hears of him today!

At the opening of the session at the University of Pennsylvania for the academic year 1793-1794 there was enrolled one Elisha North,

destined to inaugurate a distinct epoch in the practice; indeed, he became a pioneer of ophthalmology in America. North, who had never received a diploma, assisted his father, a self-trained country practitioner in Goshen, Conn. He secured an apprenticeship to a prominent physician in Hartford, Conn., and later came to Philadelphia because of the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Cataract.

This is produced by an opacity of the Chrystalline lens or its capsule it is sometimes accompanied with pain over the eye and this is most common in women aged people are most subject to it. When it arises from an external cause Bleeding and Mercury have been found useful but when from internal cause there is nothing that has done any good in my hands There are two modes of remedy in an opacity of the chrystalline lens Viz. by Extraction and Couching I prefer the former on several occasions 1st It produces less pain than Couching 2nd Extraction is more complete as couching is not always sufficient and the lens will rise again which it cannot when extracted it has been said the Chrystalline lens will be absorbed when depressed but I never saw a case when the lens was absorbed and when it is fluid it cannot be depressed but they say where the capsule is wounded and the fluid comes out that it will be absorbed and when the capsule is opake that certainly cannot be depressed which is frequently the case but can be extracted When the Operation for depression is performed and when an adhesion between the capsule and Iris exists it will be torn and carried a long to the bottom of the Eye and cause permanent blindness which cannot take place in extraction it could be loosened by a blunt probe.

Fig. 7.—A page from Philip Syng Physick's lectures on surgery for November 1807.

celebrity of the teachers at the University of Pennsylvania. On returning to New England in 1812, he settled in New London, Conn., and decided to devote himself to diseases of the eye, for he had doubtless received much inspiration from his teachers at the University of Pennsylvania. In 1817 he opened an infirmary for patients with diseases

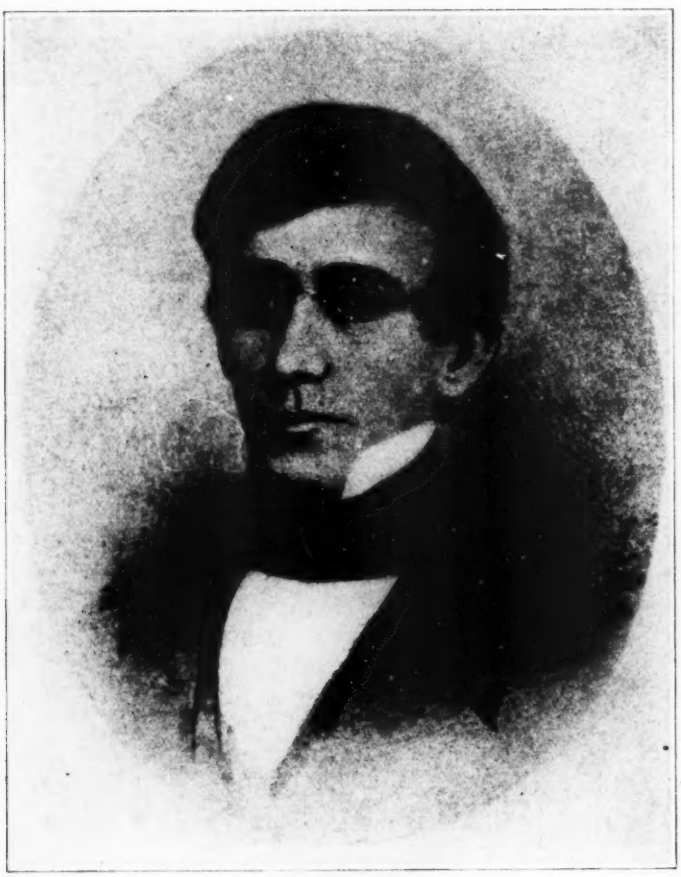
of the eye, the first in this country. That experiment, distant though its seat was from Philadelphia, was not without effect on the practice in this city, for because of it the attention of the medical profession was focused on the necessity for greater concern about diseases of the eye. Hitherto the majority of the practitioners were entirely without comprehension of the seriousness of ocular diseases and consequently

Fig. 8.—William Gibson. This photograph was taken from the portrait on wood by Joseph Wood, in the possession of the College of Physicians of Philadelphia.

had only a faint conception of the importance of the relation they bore to general medicine. North became the most distinguished practitioner of Connecticut, but he did not continue in ophthalmology.

There was no special work devoted to the diseases of the eye available in English for the guidance of early practitioners until the opening of the nineteenth century. No systematized presentation of the

pathology of the eye existed in any language until James Wardrop, a distinguished surgeon in London, issued his treatise in 1808. Wardrop was the author of the infamous and offensive "Intercepted Letters," published in the early issues of the *Lancet,* in certain of which, despite his own skill in ophthalmic surgery, he violently opposed the establishment of an ophthalmic hospital in London.



GEORGE FRICK

1793-1870.

Fig. 9.—George Frick.

The first work on ophthalmology published in America was "A Treatise on the Diseases of the Eye; Including the Doctrines and Practice of the Most Modern Surgeons, and Particularly Those of Professor Beer," written by George Frick, a native of Baltimore. After receiving his degree at the University of Pennsylvania, in 1815, Frick went to Vienna to study under Dr. George Joseph Beer, at that day the foremost ophthalmologist in Europe. Beer had been one of the

two students chosen by Joseph Barth, celebrated as the first "Professor" of ophthalmology in medical history.

Barth was an uneducated and illiterate man who had acquired extraordinary facility in operating for cataract; he had learned how to perform this operation from watching the celebrated Baron Wenzel.

A

TREATISE

ON THE

DISEASES OF THE EYE;

INCLUDING THE

Doctrines and Practice

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BY GEORGE FRICK, M. D.

M. A. of H.

Ophthalmic Surgeon to the Baltimore General Dispensary.

WITH AN ENGRAVING.

Baltimore:

PUBLISHED BY FIELDING LUCAS, JUN.

JOHN D. TOY, PRINTER.

1823.

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A NEW EDITION WITH NOTES,

BY RICHARD WELBANK,

MEMBER OF THE ROYAL COLLEGE OF SURGEONS, AND OF THE MEDICAL AND CHIRURGICAL SOCIETY OF LONDON.

With an Engraving.

LONDON

PRINTED FOR JOHN ANDERSON,

MEDICAL BOOKSELLER, WEST SMITHFIELD;

ADAM BLACK, EDINBURGH; W. R. M'PHUN, GLASGOW; AND

HODGES AND M'ARTHUR, DUBLIN.

1826.

Fig. 10.—Title page of Frick's "A Treatise on the Diseases of the Eye," in the American edition and in the English edition.

Barth had been directed by the Empress Maria Theresa to teach "two young men as much as he knew and could impart on that subject." Such was the beginning of the noble Vienna school of ophthalmology.

Frick, some time after his return to America, opened an ophthalmic clinic at the Baltimore Dispensary and in 1823 established a course of

lectures in the University of Maryland, which was so systematized as rightly to be considered to have been the first regular course in ophthalmology in America. His book, which he dedicated to Dr. Physick, published in 1823, a more or less formal presentation of those lectures, served as the leading textbook for Americans for several years, and in 1826 an edition was issued in England.

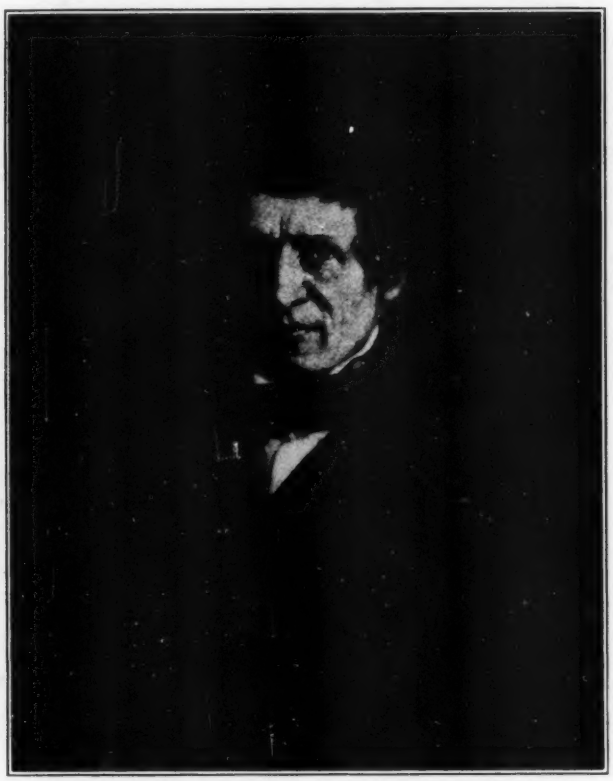

Fig. 11.—George McClellan.

In Philadelphia, in the meantime, through the efforts of certain earnest graduates of the University of Pennsylvania, the Jefferson Medical College of Philadelphia was being organized. Foremost among the founders was George McClellan, a former pupil of Physick, the professor of surgery and anatomy, who because of an interest in ophthalmologic subjects endeavored to devote some time in his general lectures to the exposition of the diseases of the eye.

All those whose names I have mentioned [1] had been under the tutelage of Professor Physick, who properly may be considered to be the "father of American ophthalmology" as well as the "father of American surgery." Therefore, Physick, Dorsey, Gibson and McClellan were the forerunners of ophthalmology in Philadelphia. These four

Diseases of the Eye. 277

CHAPTER X.

DISEASES OF THE EYE.

THE eye, from its delicate and complex structure, and the number and diversity of its diseases, was formerly much neglected, especially in Europe, by the regular members of the profession, and attended to almost exclusively by ignorant and itinerant oculists. Within the last twenty years, however, the value of this important branch of surgery has been duly estimated, in proof of which it need only be mentioned that Ware, Saunders, Gibson of Manchester, Adams, Wardrop, Travers, Vetch, in Britain, and Scarpa, Beer, Schmidt, and others on the continent, have contributed largely by their writings and operations to elevate this department to a most respectable rank. Many of these gentlemen, indeed, forsaking the general practice of their profession, have devoted their whole attention to ophthalmic surgery, and with a result truly honourable to themselves, and glorious to their country.

The most common affection, perhaps, of the eye, is ophthalmia. Of this, therefore, it will be proper first to treat. Ophthalmia is employed by most modern writers as a generic phrase —denoting ocular inflammation. For the sake of precision and accurate discrimination, other terms have been invented, some of them simple and expressive enough, others formidable in the extreme, or altogether monstrous.* To elucidate the varieties

* Nothing short of affectation or pedantry will enable us to tolerate, in many instances, the phraseology of Beer and Schmidt—such as opthalmo-blennorrhœa, blepharo-opthalmo-blennorrhœa, dacryoadenitis, blepharophalmitis idiopathica,

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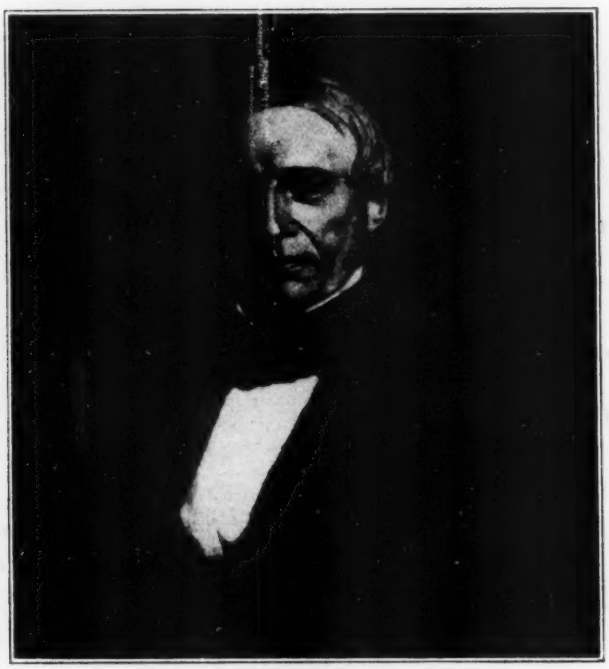
Fig. 12.—A page from McClellan's "Principles and Practice of Surgery."

surgeons were more or less familiar with medical affairs in London and were much influenced thereby. The great "Moorfields" ophthalmic hospital, established in 1805, had begun to attract the attention of

1. None was a Fellow of the College of Physicians of Philadelphia, because at that period the fellowship was confined to "physicians."

Americans. An infirmary for patients with diseases of the eye and ear had been opened in New York in 1820, and a similar infirmary was opened in Boston in 1824. In 1821 McClellan opened a "Dispensary for Diseases of the Eye" near Sixth and Walnut Streets. That dispensary struggled along for a year or so, after which it was displaced by "The Pennsylvania Infirmary for Diseases of the Eye and



ISAAC HAYS.M.D.

Isaac Hays

SURGEON TO WILLS HOSPITAL

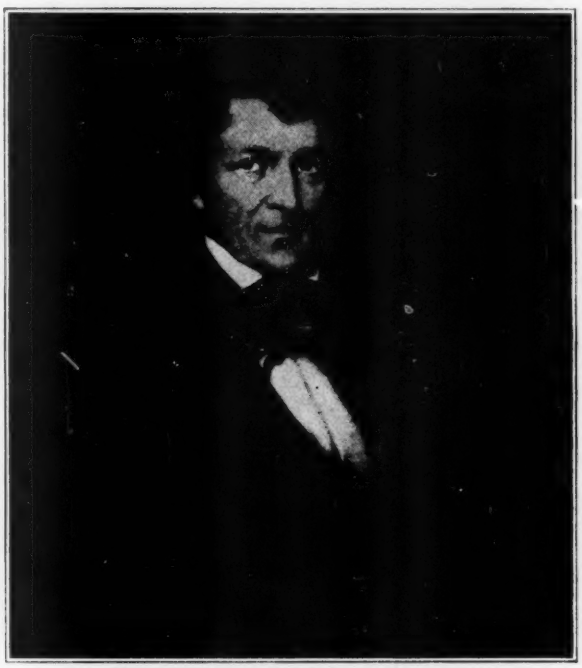
Editor of the American Journal of the Medical Sciences &c.

Phil.ª Pub.d by Barrison, 39 So.th 6th St.

Fig. 13.—Isaac Hays.

Ear," organized in February 1822 at a house on Seventh Street, near Market Street by a group of public-spirited citizens led by Drs. Isaac Hays and George B. Wood. The efforts of these forward-looking men were not appreciated, yet this infirmary continued till about 1829.

During the first thirty years of the nineteenth century the state of medical opinion in America was most unstable. It was a period of reconstruction; practitioners hardly knew where they stood, yet the best minds dared to hope that a scientific era might succeed that marked by the skeptical and uncertain attitude existing among both practitioners and society. In Philadelphia strife and emulation were rife, even among the most cultured practitioners of the day. The forces of



GEORGE B. WOOD. M.D.

Geo. B. Wood

Professor of Materia Medica and Pharmacy

IN THE UNIVERSITY OF PENNSYLVANIA

Philad.ª Pub.d by V.F. Harrison N.º 275 S.t 2.d

Fig. 14.—George B. Wood.

the University of Pennsylvania were indignant because of the establishment of the Jefferson Medical College. The contemptuous and distrustful demeanor exhibited by the graduates of both these schools

for the practices of those that were self-taught though already well established in the city conspired to disturb the peace of the medical profession, and because of this state of affairs society held aloof from any new projects.

Yet, in spite of these unpleasant conditions, by 1830 there had permeated into the minds of certain thoughtful persons the realization that diseases of the eye should be counted as holding an important sociologic as well as medical significance and that America should follow in the direction already set by London and Vienna and establish institutions for the care of patients so afflicted, as well as to provide opportunities for the clinical instruction of medical practitioners.

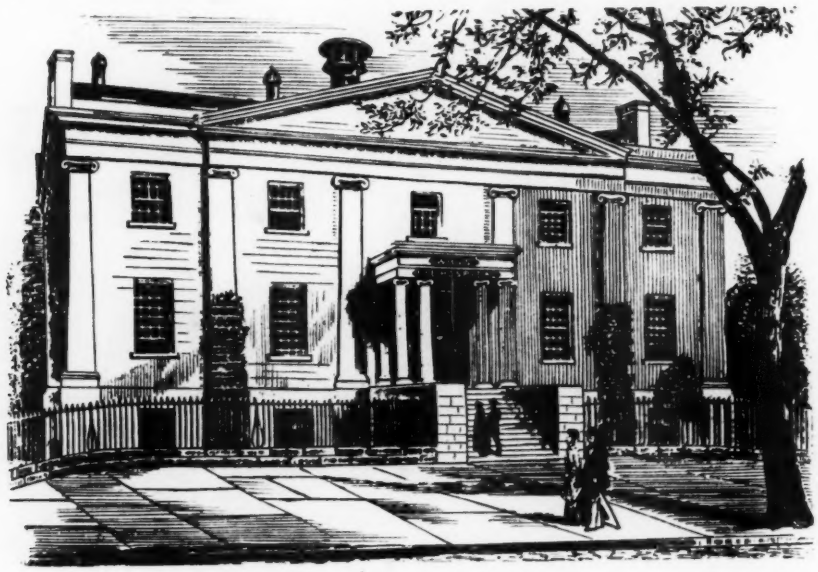


Fig. 15.—The original Wills Hospital.

The Philadelphia pupils of the teachers already named hopefully bided their time while doing what they could to carry out the principles that had been taught them. When, in 1825, a modest grocer named James Wills died, bequeathing about $115,000 of his fortune to charity, part of which was to be spent in establishing a hospital or asylum to be denominated the "Wills Hospital for the Relief of the Indigent Blind and Lame," the new era they so longed for seemed to have dawned.

After some years of dispute and litigation among the heirs of James Wills, in 1831 the Supreme Court of Pennsylvania decided that the bequest should stand. With the funds available, ground was purchased and a building erected. When the old building on Race Street opposite Logan Square was finished and opened on March 3, 1834, there was left for use and maintenance only $3,000 a year! The first

staff consisted of Isaac Parrish, a youthful but promising recent graduate, the son of a noted philanthropist, who served with ardent devotion until his death in 1852; Squier Littell, a busy practitioner, whose service extended from 1834 to 1863; Isaac Hays, a brilliant practitioner and litterateur, subsequently the editor of the famous *American Journal of the Medical Sciences,* who served from 1834 to 1849, and George Fox, who served from 1834 to 1849. Fox was a good practitioner, but he had many private interests and was a man of affairs as well.

Parrish gave a course of lectures to the students who already began to visit the hospital; these lectures, with Frick's, were the first systematic ophthalmologic lectures delivered in America.

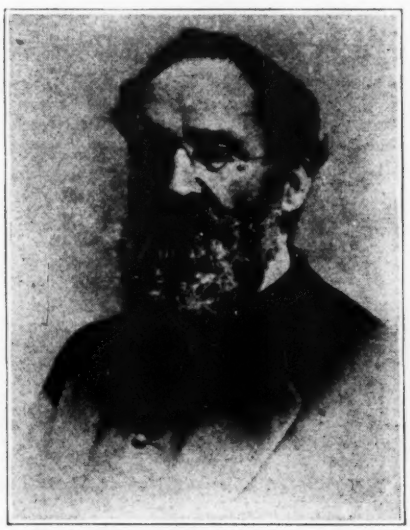


Fig. 16.—Squier Littell in 1866.

Littell had been a student of Parrish. He served as editor of several journals, and in 1837 published "A Manual of the Diseases of the Eye," an English edition of which was brought out by Hugh Houston in 1838. In 1848 a second American edition was issued which represented the experiences which Littell and his colleagues had gained by their continued service at the Wills Hospital. Besides teaching at the bedside and in the clinic, Littell contributed several papers on ophthalmologic subjects.

By 1840 the infant Philadelphia school of ophthalmology was ready to cast off its swaddling clothes. Regular teaching courses (by clinical observation of the patients) were in progress at the Wills Hospital. The members of the staff reported quarterly in the medical journals

the details of the diseases seen at the hospital. Hays devised instruments for operations for cataract. His literary activities were of the greatest helpfulness to American practitioners, and some years later he noted the occurrence of defective perception of color in association with a condition dependent on cerebral disease. Attention began to be

A

MANUAL

OF THE

DISEASES OF THE EYE.

BY

S. LITTELL, Jr., M. D.

ONE OF THE SURGEONS OF THE WILLS HOSPITAL FOR THE BLIND AND LAME, FELLOW OF THE COLLEGE OF PHYSICIANS OF PHILADELPHIA, ETC. ETC.

PUBLISHED BY

JOHN S. LITTELL,

PHILADELPHIA.

.....

1837.

Fig. 17.—Title page of the first American edition of Littell's "A Manual of the Diseases of the Eye."

called to problems connected with defects of sight dependent on errors of refraction.

The value and influence of Hays' service to ophthalmology cannot be overestimated. To begin with, he brought into the profession nobility of character and a highly cultured intellect, and, possessing

talent for literary expression, he was able to present through the issues of the journals of which he was editor essays and reports of medical topics and cases, offered by Americans, which he had chosen for their scientific usefulness, thereby attracting the attention of the best ophthalmologists both of this country and of Europe. And he analyzed the

THE

AMERICAN JOURNAL

OF THE

MEDICAL SCIENCES.

ARTICLE I. *Report of Cases treated in the Wills Hospital for the Blind and Lame during the months of October, November and December*, 1839, *with Observations.* By ISAAC HAYS, M. D., one of the Surgeons.

AMAUROSIS.—There were two cases of this disease, both convalescent, in the house when I took charge of it, and two were admitted during my term of service. One of the former and one of the latter were discharged cured; the other two remained, but somewhat improved. Three of these cases appear to us of sufficient interest to deserve some notice.

Case I. *Partial Amaurosis—Inability to distinguish certain Colours.*—Mary Bishop, ætat. 20, unmarried, segar maker, admitted February 9, 1839. The early history of this case has already been given* by my colleague, Dr. Fox; it will be sufficient, therefore, to recapitulate here merely its prominent features. The patient stated, that she had suffered, previous to admission into the hospital, two attacks of cerebral disease, one in the spring of 1837 the other in the winter of 1837–38. After recovery from the first attack, objects for a time appeared to her double. The second attack left her entirely blind, in which condition she continued for four months. After this her sight began to return, and at the period of her admission into the hospital she could read large print, as the heading of a newspaper. She was of a short, robust stature, full habit, very dark complexion, black hair and hazel irides, flushed face, colour of her cheeks at times almost of a purplish hue; catamenia suppressed. When she first came under my notice, which was

* See No. of this Journal for Nov. 1839, p. 16.

Fig. 18.—A page from the *American Journal of the Medical Sciences,* showing the report of Hays' case of the color-blind girl from the Wills Hospital.

productions from other countries, which analyses were condensed and published with strict regularity for the service of the readers in this country. It was through this editorship that he became important to the practice of ophthalmology, not only in those earliest years but well on in the later days.

Hays, being an ophthalmologist in practice, was able to present to the general reader a topic of special interest in such a manner as to impart an understanding of its importance in relation to medicine, as well as to identify the subject with the growing science of ophthalmology. It must be borne in mind that in those days there was no journal devoted to ophthalmology; the editors of journals of general medicine, however, early realized the growing importance of the specialty and welcomed contributions from practitioners. So one can find chapters on diseases of the eye in the *American Medical Reporter* and the *Journal of the Medical and Physical Sciences*, published in Philadelphia. Frick's articles on conjunctivitis, cataract and artificial pupil appeared in the *American Medical Reporter* for 1821, 1822 and 1823. These early journals were succeeded by the *American Journal of the Medical Sciences*, edited by Hays. In 1826, 1827 and 1828 appeared articles under captions the like of which are to this day a feature of that famous monthly publication. It can thus be seen how Hays advanced the dissemination of the knowledge of ophthalmology in America. Isaac Hays further benefited the native practice by editing for American readers works by English authors, notably Lawrence's famous book "A Treatise on the Diseases of the Eye."

Medical students were encouraged to select ophthalmologic topics as subjects for their graduation theses. Among these theses might be mentioned that of Isaac Cleaver, who graduated from the University of Pennsylvania in 1805, who wrote on "Cataract," dedicating his thesis to Dr. Physick. Another thesis, "The Eye and Vision," by Elisha de Butts, dedicated to Dr. Caspar Wistar, was published in the same year. A third noteworthy thesis, "On the Nature and Treatment of Cataract," dedicated to Dr. George McClellan, was by that destined to be truly great surgeon S. D. Gross, who graduated from the Jefferson Medical College in 1828. The papers here mentioned represented the knowledge obtainable in the times in which they were written.

An event of outstanding importance to the ophthalmology of the whole world occurred in Philadelphia in 1828, when John McAllister, a spectacle maker, succeeded in grinding a planoconvex cylindric lens, a glass for the correction of astigmatism. This lens was used by a man who, by reason of his inability to see distinctly at the distances commonly readily perceived by his contemporaries, believed himself to be near-sighted. It is commonly asserted that Dr. Hays was the first to prescribe cylindric glasses.

Another incident regarding Dr. Hays is that after he had observed defective perception of color in the young woman to whose case reference has already been made he learned of color blindness of congenital origin. In an issue of the *American Journal of the Medical Sciences*

in 1840 he reviewed and analyzed all the reported cases of color blindness from that reported by Dalton in 1794. Hays' reports inspired Dr. Pliny Earle, of Philadelphia, who was himself color blind, to describe in 1845 his case and the cases of the members of his own family, in which for several generations the anomaly had been known to exist.

An item I should touch on is that of the discovery of the tensor tarsi muscle by Dr. William E. Horner, a Philadelphian, the professor of anatomy at the University of Pennsylvania. In a series of minute dissections of the eyelids Horner came on delicate muscular fibers

WILLIAM E. HORNER. M. D.

W. E. Horner

Professor of Anatomy

IN THE UNIVERSITY OF PENNSYLVANIA

Fig. 19.—William E. Horner.

extending along the course of the lacrimal canal from the crest of the lacrimal bone to the lacrimal puncta, unconnected with the orbicularis muscle. This he designated the "muscle of the internal commissure," and he stated that its function was to maintain the lacrimal punctum in contact with the eyeball. His dissections were the marvels of all anatomists. If one recalls Horner's contributions to the minute anatomy

of the intestines, it is easy to comprehend how it was he who found the tensor tarsi muscle. I have more than once seen this discovery credited to another Horner, who lived at a much later time than the days of Horner of Philadelphia. Horner was born about 1790 and lived until 1853. He was succeeded at the university by Dr. Joseph Leidy, beloved by many of the fellows of the College of Physicians of Philadelphia.

The interest manifested by those who took care of "eye cases" but who scorned to be called "specialists" attracted the attention of physicians who in their general practice had begun to notice a relation between local diseases, such as diseases of the eye, and derangement of the bodily health. There was a medical staff attached to the Wills Hospital to assist the more specialized attendants. Perhaps this wide concern with ophthalmic subjects arose through Hays' publication, as already noted, of the reports presented by the surgeons at the Wills Hospital, as issued from time to time in the *American Journal of Medical Sciences*. Yet every one was aware that much that was empirical still existed in the practice of the day and that the approach to the treatment of obscure disease could therefore of necessity be only tentative. The elders could but advise juniors that because of the general ignorance of the anatomy and physiology of the eye only a judicious and discriminating use of the means already at hand should be resorted to rather than the putting into practice of ideas of treatment suggested by incompletely understood manifestations of the pathologic processes observed in that organ. The staff at the Wills Hospital accordingly pleaded earnestly for the further establishment and maintenance of special departments in hospitals in which all phases of ophthalmic medicine might be studied. The highly equipped ophthalmic institutes raising their heads today are but the offspring of the Wills Hospital and the other ophthalmic hospitals opened in the early years of the last century in the cities of Baltimore, New York and Boston.

In the early days at the Wills Hospital the patients were cared for only by being taken into the institution, where small wards had been arranged for them. It was not until some time later that "persons whose infirmities allowed them to attend on the stated days of the surgeons' visits" were accepted for consultation and treatment as outpatients. As the fame of the hospital and the prominence of the city as a medical center extended, the number of applicants rapidly increased day by day, and the dispensary service soon became firmly organized.

It was the "age of clinical intuition," brilliant in its comprehension of the manifestations of the external diseases of the eye. No disorder not visible to the observer's eye was understood, yet one must admire the struggles of observers during that period. With the means at hand all was done that could be, but practitioners waited expectantly till some magician's wand might wave and cause the effulgence of the aided

scientific study to shine and light the way to "modern ophthalmology." That magic wand was the ophthalmoscope, with which truly a new world was opened. The invention of the ophthalmoscope in 1851 affected all the medical sciences. There is not space here to tell how the use of that simple instrument cleared up the mysteries of "amblyopia," "amaurosis" and other vaguely comprehended diseases, and how with it the differential diagnosis between cataract and glaucoma was ascertained; nor is there space to describe the diseases of the ocular tunics observable with it. During the first half of the nineteenth century the achievements in operative surgery placed the surgeons in the front rank of the medical profession and largely contributed to the maintenance of the position of Philadelphia as the medical center of the country. There is not space to tell of the influence that the growing ophthalmologic science had on neurology and of the part investigators in Philadelphia took in the development of the ophthalmoneurology of the world, and, lastly, what the investigation into the state of the refraction of school children in Philadelphia has done in the world-wide preservation of the sight of children and adolescents, not to speak of the comfort and health afforded by spectacles to all classes of society, obtained through the correction of the anomalies of refraction. All these chapters, and more, were developed, if not conceived, in Philadelphia.

In this new birth of ophthalmic medicine the efforts of Philadelphians in time became known by the whole medical world. Today, one can find in the annals of ophthalmologic history the records of the contributions made to the science by those early ophthalmologists of this city, the fruits of which the universe can enjoy.

SUGGESTIONS FOR PREVENTION OF OCULAR AND AURAL SEQUELAE OF MENINGOCOCCIC MENINGITIS

WELLS P. EAGLETON, M.D.
NEWARK, N. J.

Dr. Heath has carefully analyzed a large number of cases of meningococcic meningitis and shown the frequency of the different ocular sequelae. All I can add is a comparison between the lesions of this disease and those of suppurative meningitis of aural or nasal origin.

Taking his findings as a basis, I am going to suggest that physicians attempt to prevent the ocular sequelae of meningococcic meningitis by treating the various lesions causing the ocular disturbance at the site of the embolic infarction in a manner similar to that now employed in the treatment of suppurative meningitis.

In dissecting injected heads,[1] I noticed several anatomic facts to which my attention had never before been directed. All have been of assistance to me in the early diagnosis and treatment, as well as in arriving at an understanding of the sequelae, of any form of meningitis.

1. A (*a*) sensory cranial nerve has a prolongation of arachnoid which surrounds it for some distance after it has entered the dura, so that the anatomist can immediately recognize its sensory character by this arachnoid protection. A (*b*) motor cranial nerve has no such arachnoid prolongation, losing its covering immediately as it enters the dura, so that a slight displacement of the brain is likely to cause paralysis of a motor nerve, be it the sixth, third or fourth, while all sensory nerves are spared.

2. It is in the subarachnoid prolongations of the basal cistern surrounding a sensory nerve that accumulations of exudate lodge, and these accumulations are the cause of many symptoms. When firmly organized they are the cause of the sequelae of pyogenic meningitis.

3. When I attempted, by gravity, to fill the subarachnoid system with colored fluid, flowing from the inner ear, after I had removed the

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Read before the American Academy of Ophthalmology and Otolaryngology, New York, Oct. 1, 1936.

Suggested by Dr. Parker Heath's (Detroit) paper "Visual Sequelae from Epidemic Meningococcus Meningitis."

1. Eagleton, W. P.: Localized Bulbar Cisterna (Pontile) Meningitis, Facial Pain and Sixth Nerve Paralysis and Their Relation to Caries of the Petrous Apex, Arch. Surg. **20**:386 (March) 1930.

outer labyrinthine wall, I found the communications between the arachnoid spaces in the peripheral prolongations to be so small that the granules of dye pigment held in suspension could not pass, while the watery fluid solution of the dye would pass.

4. It is the obliteration by adhesions of these fine arachnoid passages that prevents the spread of infections to all parts of the system in pyogenic meningitis from the ear or nose.

These anatomic facts are of importance in diagnosing the location of the infection from the symptoms in cases of suppurative meningitis. Adhesions are also the cause of sequelae in patients who recover.

All these anatomic factors play a great but less prominent part in meningococcic meningitis. For it should be emphasized that the germ of epidemic cerebrospinal meningitis acts differently from any other pus-producing germ. The meningococcus (*a*) is not of great virulence and (*b*) "has comparatively little surviving power when brought into contact with mesodermal tissues although it (*c*) can live for some time when in relation to ectodermal cells." [2] And meningococcic infection is primarily "a meningococcic sepsis with a secondary meningeal localization" (Herrick [3]).

While all other pyogenic meningeal infections—streptococcic, pneumococcic and staphylococcic—form a local focus of infection in the bone of the ear or nose, the blood stream is sterile until the terminal stage, that is, when the hemocerebrospinal fluid barrier between the blood vessels and the arachnoid mesh breaks down and allows germs to enter the blood stream. From this time on the patient has not meningitis alone but meningo-encephalitis, from which, in my experience, none recover.

However, in meningococcic infections the blood stream is invaded before the arachnoid spaces, while the cranial nerves are not attacked by pressure, as the vascular nature of the infection causes embolic infarcts or toxins (Wertham [4]) to act directly on small vessels of the ependyma, on the cerebral tissue or on its nerves after leaving the brain.

Thus the ocular motor paralysis resulting from meningococcic meningitis, is due not to pressure from an exudate but to changes in the cerebral tissue itself or damage to its nuclei.

The meningococcus stands in its virulence and mode of invasion midway between the pyogenic germs, such as the streptococcus and the

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2. Greenfield, J. H.: Inflammatory Cells in the Central Nervous System, in Penfield, Wilder: Cytology and Cellular Pathology of the Nervous System, New York, Paul B. Hoeber, Inc., 1932, vol. 3, p. 1229.

3. Herrick, W. W.: Early Diagnosis and Intravenous Serum Treatment of Epidemic Cerebrospinal Meningitis, J. A. M. A. **71**:612 (Aug. 24) 1918.

4. Wertham, Frederic: The Cerebral Lesions in Purulent Meningitis, Arch. Neurol. & Psychiat. **26**:549 (Sept.) 1931.

pneumococcus, and the neutropic viruses, which cause poliomyelitis and encephalitis. However, there is a specific meningococcus serum that acts immediately if it can be brought into contact with the micro-organism.

The meningococcus generally disappears from the blood at an early date.

In the vast majority of the cases observed at the Essex County Hospital for Contagious Diseases, at Belleville, N. J., (*a*) the blood stream has become sterile before the diagnosis of meningococcic meningitis has been made by examination of cerebrospinal fluid removed by lumbar puncture, although in a few cases (*b*) the meningococcus was still to be isolated from the nasal secretions.

OCULAR AND AUDITORY SYMPTOMS

The Perineuritis of Meningococcic Infection and the Papilledema of Other Pyogenic Meningitides.—The optic nerve is involved as a perineurositis.[5] There is no papilledema from pressure, in contradistinction to the papilledema in meningitis of pyogenic origin, when the optic prolongation of the third ventricle presses on the chiasm.

The Difference in the Auditory Symptoms.—The impairment of hearing associated with pyogenic meningitis is due to effusions in the arachnoid space; the deafness is never complete, because the eighth nerve withstands pressure well. On the other hand, the deafness associated with meningococcic meningitis is generally complete, because the disease involves the vessels of the nerve tissue itself, either in the labyrinth or in the brain.

With the protective exudate of the posterior fossa which develops in association with labyrinthitis or fracture of the skull, the time of the vestibular reaction to turning is reduced to about 50 per cent, and this continues indefinitely, as I[6] pointed out in 1922, although there are no vestibular symptoms of nystagmus at the time of invasion. However, with the embolic process of meningococcic infection, nystagmus is present for some time immediately after the invasion of the labyrinth.

TREATMENT

Suggestion of Injection of Meningococcus Serum Directly Into the Site of the Lesion.—I suggest that the therapeutist from the beginning of meningococcic meningitis try to differentiate (1) embolic lesions of the blood stream (such as the intra-ocular effusions) from (2) those

5. Lewis, P. M.: Ocular Neuropathies and Amauroses in Meningococcic Meningitis, South. M. J. **24**:101 (Feb.) 1931.

6. Eagleton, W. P.: The Reduction from Turning in Diffuse Lesions of the Cerebrospinal System Pathways Over the Cerebellar Cortex as in Protective Meningitis, Tr. Am. Laryng., Rhin. & Otol. Soc. **28**:231, 1922.

due to cerebral meningo-encephalitis, and that serum be applied as near the site of the lesion as is possible. This utilizes the principle of directly attacking the site of the lesion, as is now the universal practice in the surgical treatment of streptococcic and pneumococcic meningitis from the ear or nose.

In cases in which there is vertical nystagmus, putting serum into the basal cistern should be tried, as in all such cases up to the present time the condition has terminated fatally.

Meningococcic Panophthalmitis.—If emboli lodge in the eyeball the injection of serum into the anterior chamber or even into the vitreous might be tried, as in all such cases the condition ends in blindness and is known to be of blood vessel origin. This procedure was advocated by Netter [7] in 1915.

Intracranial Pressure.—Increased intracranial pressure due to meningococcus meningitis can be relieved surgically. With this treatment I have had a limited, but successful, experience.

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7. Netter, A.: Guérison de l'iridochoroïdite suppurée à méningocoques par les injections de sérum antiméningococcique dans le corps vitré, Compt. rend. Soc. de biol. **78**:90, 1915.

ADENOCARCINOMA OF A MEIBOMIAN GLAND

REPORT OF ADDITIONAL CASES

A. HAGEDOORN, M.D.

AMSTERDAM, NETHERLANDS

The basic architectural feature of a tumor (case 1) described in a previous article in the ARCHIVES [1] seemed to be the band of sebaceous mother cells and sebaceous cells (figs. 4 and 5 of that article). Besides that, cells closely related to pavement epithelial cells were present, which grew between the sebaceous cells (fig. 7 of the article mentioned). In some areas the bands were very broad, and islands of sebaceous cells appeared without definite sebaceous mother cells (seen in the right portion of figure 6 of the aforementioned article), side by side with large areas of cells of the second type (seen in the left portion of figure 6 of the article already referred to). The metastatic tumors consisted of a mixture of the two constituent elements of the original tumor (these are seen in figure 8 of the aforementioned article, which especially demonstrates the sebaceous tumor cells).

The supposed basic architecture of this tumor, the band of cells, was universally present in a second case of a tumor of this kind that I was able to study (fig. 1). The report of this case is as follows:

CASE 2.—An elderly man was treated for some time for a tumor of the superior eyelid; finally, as suspicion arose that the swelling of the lid might be caused by a malignant growth, the eyelid was removed and sent to me for histologic examination. A section from the surface of this tumor showed a massive medullary mass divided into irregular fields by slender septums. Microscopically, the tumor was divided into a number of irregular fields by a skeleton of fine and coarse septums of connective tissue. On these septums—and around the blood vessels—epithelial cells were arranged, generally with their long axis perpendicular to the septums. The nuclei were round or oblong, and occasionally more elongated or irregular ones were seen. They possessed a nuclear wall that colored well and had a delicate structure, with generally one, sometimes two, and, rarely, three or no nucleoli. There was a well developed protoplasm, often already vacuolated, as in higher layers. On top of this more or less regular layer there were further layers of irregularly arranged cells. Often, however, it was hard to distinguish between sebaceous mother cells and sebaceous cells. The nuclei of the latter cells, which generally had also one or two nucleoli, lay further apart in the higher layers, as the cells were larger, the protoplasm being highly vacuolated in the ordinary

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From the Department of Ophthalmology of the University of Amsterdam.

1. Hagedoorn, A.: Adenocarcinoma of a Meibomian Gland, Arch. Ophth. **12**:850 (Dec.) 1934.

Fig. 1 (case 2).—Photomicrograph showing the structure of the tumor.

sections by the solution of the alcohol-soluble substances they contained. These were preserved in the frozen sections and stained with sudan III. Double-breaking substances, however, were practically absent. These bands of cells covered the septums of connective tissue, so that in the center a hole might be present, filled with fatty material. Though larger cysts were seen histologically, they were so completely filled with fatty material that macroscopically the tumor seemed to be massive on section. At other places an area marked off by thick walls of connective tissue seemed to be filled by these bands of cells arranged on a slender basal membrane of connective tissue, closely folded together. Most of the nuclei were nearly round or oblong; some, however, were more elongated, and lay in streams. The majority of these cells stained with sudan III as well. The elongated nucleus is atypical for the sebaceous cell, but in this tumor, even though the nucleus was darker and the protoplasm not vacuolated, keratohyaline and horn cells could never be seen, nor could I observe areas of prickle cells, as in the first case. As these nuclei had degenerated, for instance, in the central parts of the cysts, they had become smaller and stained more intensively. Occasionally, cells with a very large nucleus and peculiar cell forms were met with. There were numerous mitosis, more than in the first case. The tumor cells contained glycogen. This was also abundantly present in the surface epithelium, especially in those areas in which

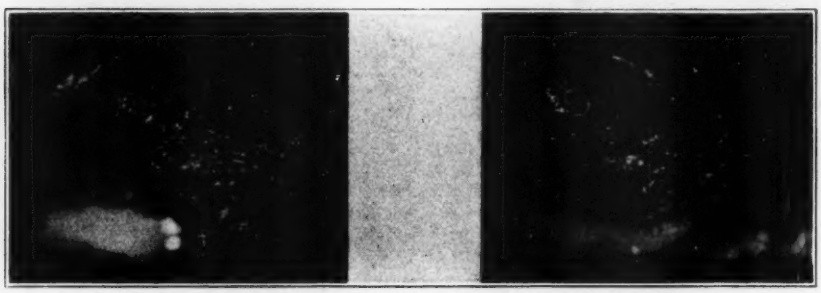

Fig. 2 (case 4).—Stereophotograph of the tumor.

the latter was decidedly hypertrophic over the tumor. The glycogen content of these cells seemed abnormally high compared with that of the cells of similarly colored sections of normal skin.

Gans,[2] in his book on the histologic features of diseases of the skin, gave a diagram (fig. 162) showing "secondary prickle cell proliferation in a case of basal cell carcinoma" and the coloring of glycogen in cases of basal cell carcinoma. The significance of the proliferation of prickle cells and of the high glycogen content of these cells is not yet clear. This high glycogen content of pathologic cells is also present in Paget's disease and Bowen's disease (called precarcinoma by some authors) and in cases of experimental tar carcinoma. If one intends to demonstrate glycogen the material should be fixed in a solution of dextrose and formaldehyde (Romeis[3]).

2. Gans, O.: Histologie der Hautkrankheiten, Berlin, Julius Springer, 1928, vol. 2, p. 327.

3. Romeis, B.: Taschenbuch der mikroskopischen Technik, ed. 13, Berlin, R. Oldenbourg, 1932.

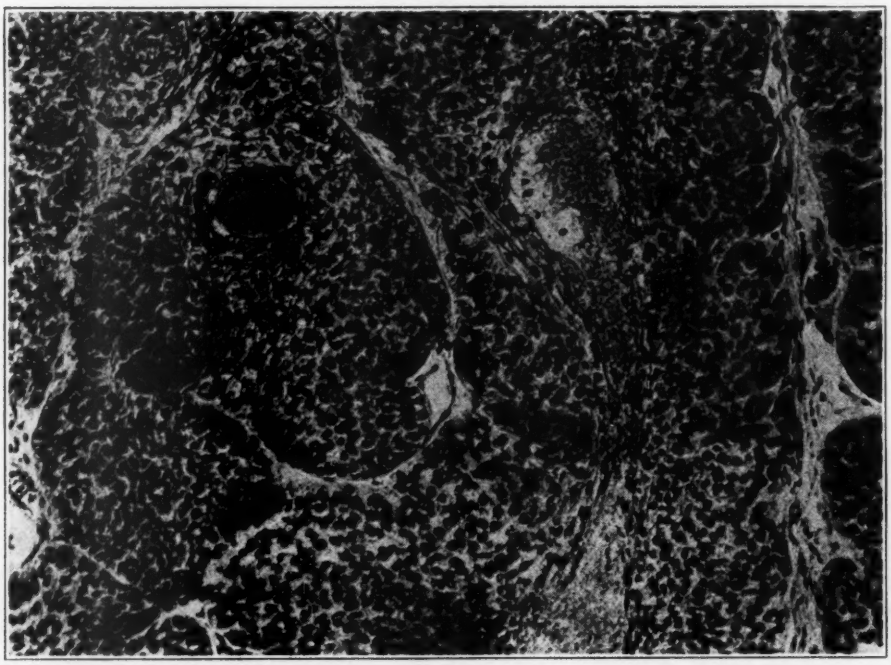

Fig. 3 (case 4).—Photomicrograph showing the structure of the tumor.

Fig. 4.—Histologic aspect of basal cell carcinoma resembling adenocarcinoma.

The observations in the case of this tumor of a meibomian gland induced me to examine the collection of pathologic specimens in the University Eye Laboratory. One tumor was present which was an adenocarcinoma (case 3).

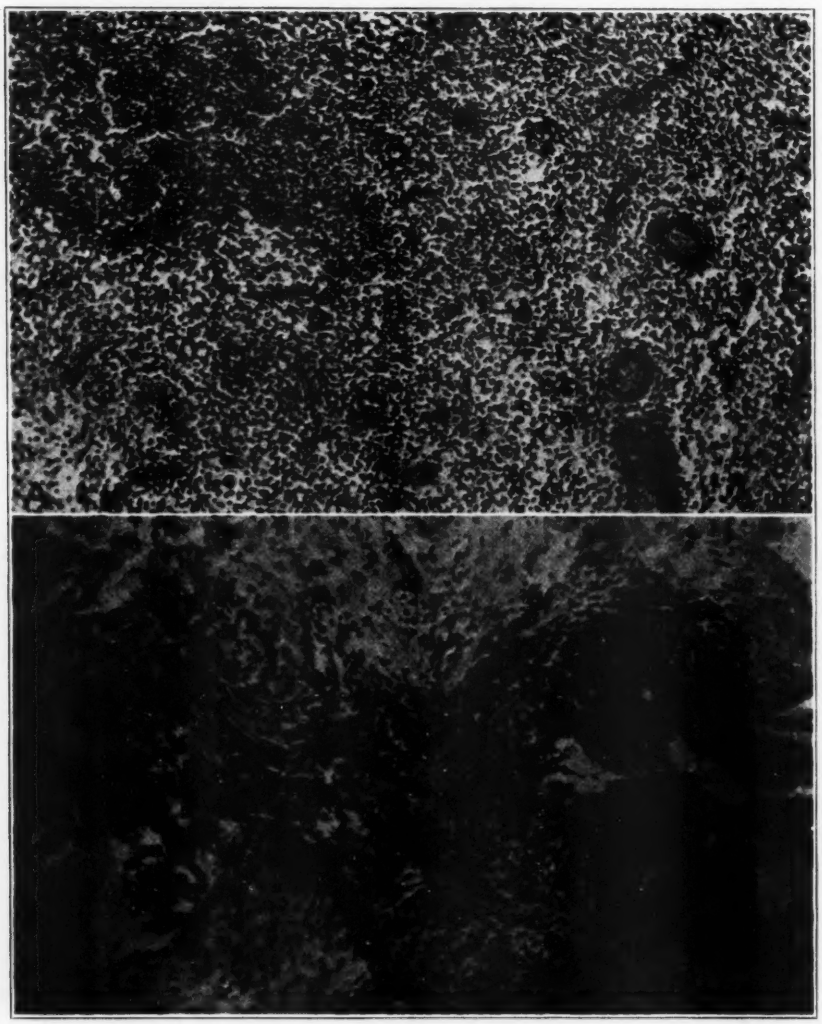

Fig. 5.—Histologic appearance of (*A*) an ordinary chalazion and (*B*) basal cell carcinoma.

CASE 3.—A woman 50 years of age discovered a small nodule in the upper eyelid of one eye three years before she came under treatment. Since then the tumor had gradually increased in size. There were at the first examination a small tumor the size of a pea in the center of the eyelid and some smaller nodules at the temporal side. The eyelid was temporarily fixed on the forehead, and radium was applied. After treatment the eyelid was restored to its normal position.

After seven months a chalazion developed, which was treated in the usual way. Two months later there was a recurrence of the tumor, and the temporal part of the eyelid was removed.

Histologically, the tumor was a typical adenocarcinoma. Many cysts were present, which were filled with granulation tissue like that observed in a chalazion, with many dilated vessels. This is the reaction on necrosis of fat (lipogranulomatosis [4]) and was perhaps caused by the irradiation.

It should be stated here that Lebensohn's [5] patient was cured by radium treatment, so that this treatment, which gives excellent results in cases of other cancers of the lid, should be tried in cases of adenocarcinoma in which it is suitable.

Recently I saw a variety of adenocarcinoma resembling granuloma or papilloma (case 4).

CASE 4.—A few months before the patient was seen the ophthalmologist removed a chalazion. A tumor gradually developed. However, the patient did not return until it had grown to the size shown in figure 2. It was of a much firmer consistency than granulomas, which may develop in cases of chalazion.

A wedge-shaped part of the eyelid was removed, together with the tumor. On section the intrapalpebral part appeared to be sharply marked off against the normal tarsal tissue. Histologically, the tumor was a typical adenocarcinoma of a meibomian gland. The structure was not so regular as that of the tumor in case 2 (fig. 1), and in several places a layer of sebaceous mother cells was not clearly present. Figure 3 shows a body resembling a horn pearl lying among the sebaceous cells.

The tumor did not show infiltrative growth; it was sharply marked off from the surrounding tissue and surrounded by mononuclear cells (lymphocytes and plasma cells). The conjunctiva was decidedly hypertrophic in the neighborhood of the tumor.

COMMENT

In some other carcinomas of the eyelid the number of cells containing substances coloring with sudan III was considerable, and certain areas even resembled adenocarcinoma. Figure 4 demonstrates the histologic aspect of such a tumor, which should be labeled simply basal cell carcinoma. Evidently in this region basal cell carcinoma may show features of adenocarcinoma, and of course there will be found transitional stages in which classification is difficult.

Adenocarcinoma of a meibomian gland is not so rare as is generally supposed.[6] Since my previous paper appeared ten new cases have been described, and I have heard of three cases by personal communication. The majority of these tumors have been taken for a chalazion at their

4. Hagedoorn, A.: Chalazion-Lipogranulomatosis, Am. J. Ophth. **18**:424, 1935.

5. Lebensohn, J.: Primary Carcinoma of Meibomian Gland, Am. J. Ophth. **18**:552, 1935.

6. von Hippel, in Axenfeld, T.: Lehrbuch und Atlas der Augenheilkunde, Jena, Gustav Fischer, 1935.

onset. Therefore it seems wise—if a chalazion has a somewhat unusual consistency—to examine microscopically the material obtained. Thus, in a case of basal cell carcinoma the growth could be detected at an early stage (fig. 5). One must be careful, in examining such material, not to mistake fragments of diseased meibomian gland for carcinoma cells. A few days later the suspected area was removed. The tumor was a basal cell carcinoma, which had apparently originated from the hair follicles. Up to now there has been no recurrence.

The observations in this case show that a tumor suggesting a chalazion is not identical with adenocarcinoma of a meibomian gland. Recently, Vele[7] described a fibrosarcoma of the eyelid which had been considered a chalazion and treated as such.

SUMMARY AND CONCLUSIONS

Adenomas of sebaceous and sweat glands when described by pathologists and dermatologists are classified as nevi in the sense of Darier and Gans. In cases of adenocarcinoma of a meibomian gland there is no doubt as to the blastomatous nature of the growth (though of course it is not impossible that in some cases the tumor may originate from a nevus). As is clear from the foregoing reports and comments, this tumor is not a basal cell carcinoma or a prickle cell carcinoma. It is a special variety of glandular carcinoma and deserves an independent place among other special carcinomas, a place which it has not acquired up till now, as it is not mentioned in the textbooks of pathology. It consists chiefly of bands of sebaceous mother cells and sebaceous cells, or—if it is less regular—of solid masses of sebaceous cells, cysts and papiloma-like growths. Besides that, in my cases cells were present with a tendency to metamorphose as cells of stratified epithelium, which appears to be a second minor characteristic of these tumors. The anlage from which a meibomian gland develops possesses both potencies of differentiation, as the ducts of the glands are lined with cells which assume the characteristics of stratified epithelium near the orifices; even the latent potency to develop a hair may become manifest (distichiasis congenita vera).

7. Vele, Maria: Sui tumori delle palpebre, Boll. d'ocul. **12**:788, 1933.

USE OF SUCROSE PREPARATORY TO SURGICAL TREATMENT OF GLAUCOMA

A PRELIMINARY REPORT

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The preparation of patients who require surgical treatment for glaucoma is as important as that of patients with any other condition which requires operation in which an inclosed cavity of the body is unable to dispose properly of an excess of the products which normally occupy it.

Methods are employed to relieve the distention of the bowel in cases of obstruction, or of the urinary bladder in cases of prostatic hypertrophy, and to reduce the intracranial pressure in cases of disease or trauma that is attended by an increase of contents before surgical treatment is undertaken. An attempt is made to decompress the engorged viscus slowly so that no damage may be done to the vascular channels supplying it. These channels have been functioning under a greater level of pressure than a normal state requires. A sudden release of pressure in a cavity would deprive the walls of the vessels of their accustomed exterior support and thus expose them to possible danger from the increased pressure within themselves until a safe level of pressure could be reestablished. The liability to accident is greater in patients who have vascular changes due to disease or senility, and many patients who have glaucoma are so affected.

Various procedures have been used to decompress the eye slowly and gradually, previous to surgical intervention, in cases of all types of glaucoma in which there is a relatively high tension. The principal objectives are to minimize the danger of intra-ocular hemorrhage from vascular accidents, and to avoid distortion of, or injury to, other intra-ocular structures, which might occur with the sudden release of aqueous at the time of operation. No surgical procedure that we know of can release the pressure slowly enough to accomplish the desired result, because the high level of pressure in the intra-ocular vascular system persists for a considerable time after any type of surgical decompression.

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Eli Lilly and Company provided the 50 per cent solution of sucrose in ampules for the patients treated in the Indianapolis City Hospital.

Several procedures have been devised and generally accepted as safe in surgical intervention for glaucoma; each has objectionable features. Paracentesis has a temporary effect only; if surgical decompression is not performed immediately, there is danger of a secondary rise of the tension to the former level or a higher level. The engorgement of the episcleral veins at the limbus may complicate the operation and convalescence by hemorrhage and subsequent hyphemia. The effect of a retrobulbar injection of procaine hydrochloride and epinephrine hydrochloride is also temporary; the fall in the tension is not great or dependable. Any manifest reduction in the tension may be due to the loss of tone in the extra-ocular muscles or to the lessened amount of blood flowing into the eye rather than to any actual loss of excess fluid in the eyeball. The effect of miotics is slow and uncertain, owing, probably, to the congestion of the tissues, which limits their absorption. Purgation and diaphoresis are adjuncts to any of the aforementioned measures and in a debilitated patient might seriously disturb the water balance.

Hypertonic solutions given by intravenous injection have been tried in the effort to accomplish lowering of the tension. In the past the results have been inconstant and unsatisfactory, owing, possibly, to the variable capacity for assimilation, absorption and excretion of different persons. The rationale of such therapy has a plausible hypothetic basis in the concepts concerning the formation of aqueous by either dialysis or filtration.[1] The failures of such therapy have discredited not the theory but rather the agents employed. Hypertonic saline solutions have not been satisfactory because of their rapid excretion by the kidneys and skin and in the expired air and their ready diffusibility out of the vascular channels into the aqueous. Dextrose has been employed with good results in some cases, but the results have been inconstant and therefore undependable. Dextrose is rapidly excreted by the kidneys, and a considerable portion of it is taken up and stored in the liver and muscles in the form of glycogen. Also, it is diffusible into the aqueous.

The ideal preparation must have the properties of not being diffusible into the aqueous, of producing a hypertonic effect in the blood stream for the purpose of directing the osmotic flow away from the aqueous into the blood stream, and then of being excreted completely by the kidneys.

Sucrose possesses many desirable features when used intravenously. The molecule is relatively large and will not readily pass through the capillary wall into the perivascular spaces; it is not broken down and

1. Duke-Elder, W. S.: Text-Book of Ophthalmology, London, Henry Kimpton, 1932, vol. 1.

therefore remains intact in the blood stream. Sucrose is not absorbed by any of the tissues of the body; it is excreted wholly by the kidneys. It is not contraindicated in diabetes.

There is a similarity in the manner of the formation and circulation of the aqueous and the cerebrospinal fluid. Any preparation which relieves the intracranial pressure in cases of cerebral edema should be in a like manner effective in glaucoma. The intravenous injection of hypertonic solutions of dextrose have been used for a number of years to reduce cerebral edema in cases in which the condition is usually of traumatic origin, but the results have been inconstant and in some instances have been complicated by a secondary rise in the pressure.

The work of Masserman [2] with regard to the use of hypertonic solutions of sucrose in the reduction of the intracranial tension in intact brains led to the employment of this substance by Hahn and his associates [3] for the reduction of excessive pressure in patients with trauma seen at the Indianapolis City Hospital. Having observed the results obtained by Hahn and his co-workers in the use of sucrose in the preparation for operation of patients with injuries of the brain, we were inspired to investigate the possible value of a like preparation in cases of glaucoma in which there was a relatively high intra-ocular tension.

Thus far we have used sucrose intravenously preliminary to thirty operations on twenty patients. Thirty-five or more injections have been made. As a routine, 400 cc. of a 25 per cent solution is injected slowly into the vein, from forty-five to sixty minutes being allowed for the entire quantity to be injected. This substance has been used in cases of all types of glaucoma, whether primary or secondary, in which the tension was over 40 mm. (Schiötz). Thus far our results have been uniformly encouraging. We have found no contraindications to the use of the method, except, perhaps, markedly low renal function. In patients with the latter condition, there was no damage as a result of the use of sucrose, but the effect on the glaucomatous eye was not as marked as in those patients whose renal activity was more nearly normal. There is no contraindication to the use of this agent in diabetes.

The entire range of conditions for which sucrose may be useful has not been investigated as yet, but it is worthy of mention that this substance proved of value in several cases of iridocyclitis complicated by a considerable rise in the tension. The purpose of this report is to present our results with the use of sucrose for reducing the intra-

2. Masserman, J. H.: Effects of Intravenous Administration of Hypertonic Solutions of Sucrose, with Special Reference to Cerebrospinal Fluid Pressure, Bull. Johns Hopkins Hosp. **57**:12 (July) 1935.

3. Hahn, E. V.: Personal communication to the authors.

ocular tension previous to surgical intervention. Five illustrative cases are reported of the twenty which have been studied in the last few months in the ophthalmologic service of the Indianapolis City Hospital.

REPORT OF CASES

CASE 1.—W. D., a Negro aged 67, was admitted to the hospital on Nov. 16, 1936, with noncongestive glaucoma. Vision was limited to counting fingers at 8 inches (20.3 cm.) in the right eye and 6/15 in the left. The visual fields showed a pronounced Rönne step for the right eye and Bjerrum's scotoma for the left. The tension was 45 mm. (Schiötz) in each eye. On November 19 the patient was given 400 cc. of a 25 per cent solution of sucrose intravenously; the entire quantity was administered over a period of about forty-five minutes. At the end of four hours the tension was 15 mm., and after twelve hours it was 12 mm. in each eye. After twenty-four hours the tension had risen to 20 mm., and after forty-eight hours the reading was 20 mm. After seventy-two hours the tension was 28 mm. in the right eye and 32 mm. in the left. On November 23 the tension was 38 mm. in each eye, and an Elliot trephine operation was performed on the right eye. Three hours before surgical intervention, sucrose was given as before, and just previous to the operation the tension was 14 mm. in each eye. There was no complication due to the surgical procedure, but it was noted that the usual "jump" of the upper portion of the iris did not occur when the blade of the trephine entered the anterior chamber. The postoperative course in this eye was uneventful. On November 27 the tension of the eye that had not been operated on had risen again to 38 mm. Miotics were used, without effect. On December 2 an Elliot trephine operation was performed on the left eye. Sucrose was given again, and the tension fell to 14 mm. The operation and convalescence were without note. The tension since that time has remained about 20 mm. The uncorrected vision was unimproved.

CASE 2.—J. G., a Negro aged 70, was admitted to the hospital on Dec. 2, 1936, with glaucoma of the left eye, which had followed extraction of a cataract. Cortical material was incarcerated in the wound. The tension was 48 mm. (Schiötz). Vision was perception of movements of the hand at 2 feet (60.9 cm.). Sucrose was given as in case 1, and the tension fell to 14 mm. Cyclodialysis held the tension within normal limits for six days, after which it returned to a constant level of about 40 mm.; miotics were ineffectual. On December 30 cyclodialysis was again performed. At this time sucrose was not available, and the patient was given 400 cc. of a 25 per cent solution of dextrose. The tension of the eye was not reduced. The second operation failed to bring the tension to normal. After consultation and at the patient's request to be relieved from pain, the eye was enucleated, on Jan. 12, 1937.

CAS 3.—W. S., a Negro aged 53, was admitted to the hospital on Oct. 2, 1936, with glaucoma of the left eye, which was secondary to traumatic subluxation of the crystalline lens. The tension was 85 mm. (Schiötz). There was no perception of light. Sucrose was given as in the other cases, and the tension fell to 22 mm. in four hours, and remained within normal limits for about thirty hours. After seventy-two hours the tension had again reached 85 mm. Sucrose was given again on October 7, and in four hours the tension was 14 mm. Thirty-six hours later, cyclodialysis was performed. The tension immediately before operation was 25 mm. The operation and convalescence were uneventful. The tension has remained within normal limits.

CASE 4.—M. Y., a Chinese man aged 63, was admitted to the hospital on Dec. 1, 1936, with a condition that had been diagnosed as acute glaucoma of the left eye. The tension was 53 mm. (Schiötz). Vision was limited to counting fingers at 7 feet (2.1 meters). Miotics did not lower the tension in twelve hours. The patient was given sucrose as in the other cases. In four hours the tension was 14 mm.; the pain had disappeared, and vision had improved to counting fingers at 15 feet (4.5 meters). A basal iridectomy was performed. The tension has remained within normal limits. Vision is now 6/60 in the affected eye.

CASE 5.—R. S., a white woman aged 67, was admitted to the hospital on Dec. 1, 1936, with acute glaucoma of the left eye. The tension was 46 mm. (Schiötz). According to the history, a solution of atropine had been instilled into this eye a few days previously. The pupillary diameter was 6 mm. An intensive use of miotics over a period of three days slowly reduced the tension to 18 mm. The tension was still within normal limits at the time of the patient's discharge on December 8. The pupillary diameter was 4 mm. The patient was instructed how to use miotics at home. The medicament prescribed was used faithfully, but when she returned to the hospital on December 13 the tension of the left eye was 52 mm. Sucrose was given, and in two hours the tension was 22 mm. A basal iridectomy was performed, which was followed by an uneventful recovery. The tension has remained normal.

COMMENT

In the cases here reported a variety of antecedent factors were present. The one common observation at the admission of the patient to the hospital was a relatively high intra-ocular tension. The patient in case 1 exhibited a uniform fall in the tension each time that sucrose was used. The reaction of the patient in case 2 made possible a direct comparison of the relative values of a disaccharide (sucrose) and a monosaccharide (dextrose) when employed under almost identical conditions in the same eye. In case 3 it was illustrated how the tension, even when very high, can be brought within normal limits in a short time. The patient in case 4 showed a marked reduction of the tension, with improvement in the congestion, clearing of corneal edema and relief from pain. In case 5 the value of sucrose when the vigorous use of miotics had failed was demonstrated. The reaction to sucrose was prompt and agreeable in all the cases.

The striking feature in the five cases reported in this paper and in others which are not reported here is that the tension was reduced to a relatively constant reading (12 to 22 mm. [Schiötz]) regardless of its height prior to the use of sucrose. We have a working hypotheses for the phenomenon which will necessitate more complete data for its proof. We hope to present this in a future publication.

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HYPERSENSITIVITY TO PONTOCAINE

REPORT OF A CASE

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Pontocaine, formerly called pantocaine (paranormobutylaminobenzoyldimethylamino-ethanol), in the form of the hydrochloride has gained great popularity as an anesthetic in the fields of medicine and surgery in this country in the last three years. In the practice of ophthalmology it is used in a 0.5 to a 2 per cent solution for instillation into the eye and has replaced many other anesthetics. In Germany it is used in a 1 : 1,000 solution for infiltration anesthesia, and in this country it is widely used in the field of general surgery for spinal anesthesia in a 1 per cent solution. So far in this country no ill effects of the drug have been reported. In Germany hypersensitivity in the eye has been reported by Janke, Mannheimer, Gebb, Rauh and others, and, in the field of surgery, by Schuberth. Since the possibility of hypersensitivity to pontocaine is not generally appreciated, it would seem well to report the following case.

REPORT OF CASE

P. B., a Jewish man of 28, while vacationing observed that vision of his left eye had become hazy and blurred on the nasal side. Since his brother had had a similar experience and was known to have detachment of the retina, he came promptly for examination. He was highly myopic and was found to have detachment of the temporal half of the retina of the left eye, extending to the fovea and without any observable perforations. Nasal hemianopia of the left eye was shown in the field plotted on the perimeter and on the tangent screen. Two drops of a 0.5 per cent solution of pontocaine was instilled into each eye for measurement of the ocular tension with the tonometer. He refused immediate hospitalization for treatment of the detachment. He returned the next day with massive edema of the eyelids, face and parotid regions, diffuse conjunctival injection, and much chemosis of each eye, with edema of the epithelium of the cornea. The swelling, which was accompanied by intense itching at first, had begun several hours after the examination and was so great that the patient was unable to open his eyes.

The patient was then admitted to the hospital, confined to bed and treated with cold compresses and instillations of epinephrine hydrochloride, and a patch test for hypersensitivity to pontocaine was made. Much sloughing of the conjunctiva occurred on the second and third days, and the edema subsided slowly until the twelfth day, when it disappeared. The skin of the arm adjacent to the patch saturated with pontocaine showed erythema after six hours, and innumerable vesicles after twelve hours when the gauze was removed. The next day the epidermis of this area sloughed away entirely. Myriads of eosinophils were noted in smears of material from the conjunctival sacs.

From the Institute of Ophthalmology, Presbyterian Hospital.

When the edema had subsided it was observed on the tenth day that the retina had become reattached. At the end of the third week the visual fields were plotted by testing with a 1.5 mm. white object and were found to be complete. Three months later the eyes were entirely normal objectively, and the fundi and visual acuity were normal.

Fig. 1.—Photograph of the patient taken on the third day after the instillation of pontocaine.

Fig. 2.—Photograph of the inner aspect of the left arm, showing the reaction to a patch test for sensitivity to pontocaine fifteen hours after injection.

COMMENT

Hypersensitivity to pontocaine is disagreeable in the individual case. It must be rare and so should not greatly lessen the position of pontocaine in the armamentarium of physicians. But it should be appreciated that this drug is capable of producing untoward effects, and when

injected subcutaneously or intraspinally in sufficient amounts into a hypersensitive person it may conceivably produce death. Tests for sensitivity to pontocaine should be advocated before it is used for injection in the field of general surgery.

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REPAIR OF CHOROIDAL DETACHMENT

REPORT OF A CASE

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Attention has been called by C. S. O'Brien [1] to the great frequency of detachment of the choroid following operation for cataract. This author found it in 93 per cent of his last series of cases. In the article on surgical intervention for glaucoma by Blaess and me [2] there are reported twenty choroidal detachments in one hundred and forty-three eyes operated on for glaucoma.

Choroidal detachment as a rule requires no treatment, for it usually disappears in less than ten days. In the series studied by Blaess and me, two detachments remained, one in a blind eye, for which nothing was done. The other detachment was in a patient with only one eye. The detachment persisted for eight months, when consent was obtained for an operative attempt at repair.

While visiting in Paris in 1932, I saw Professor Magitot do a plastic operation on an eye which had remained too soft after a Lagrange sclerectomy. I cannot recall whether there was a choroidal detachment. Magitot used a piece of Tenon's capsule to cover the scleral defect, but I never learned the result of this procedure.

TECHNIC OF OPERATION

After instilling a 4 per cent solution of cocaine into the conjunctival sac, a 1 per cent solution of procaine hydrochloride was injected subconjunctivally into the upper half of the bulb. An incision was made parallel to the limbus and 8 mm. above it. This incision was about 15 mm. long. The conjunctiva and Tenon's capsule were lifted, and the sclera was exposed to the limbus. The superior rectus muscle was picked up with a squint hook and freely exposed. The central 2 mm. was freed from the remaining portion with a small hook. A single fine silk suture was placed in this portion near the insertion, and it was cut away from the sclera with scissors. Five millimeters of the distal end of the muscle was cut off, and this portion was placed on

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1. O'Brien, C. S.: Detachment of the Choroid After Cataract Extraction: Clinical and Experimental Studies, with a Report of Seventy-Five Cases, Arch. Ophth. **14**:527 (Oct.) 1935; Further Observations on Detachment of the Choroid After Cataract Extraction, ibid. **16**:566 (Oct.) 1936.

2. Bothman, L., and Blaess, M. J.: Am. J. Ophth. **19**:1072 (Dec.) 1935.

the sclera across the trephine opening parallel to the limbus. It was fixed to the conjunctiva with three fine silk sutures. The conjunctiva was replaced, and the 15 mm. opening was closed with two silk sutures.

REPORT OF CASE

Mr. E. R. S. was first seen on May 20, 1933, at which time his vision for distance was 1.0—1. He had lacrimation while reading, and he had considerable pain after ten minutes' reading during the previous year. His vision was always better in the morning. There was no history of glaucoma. His left eye was injured forty years before by a piece of straw and was enucleated twenty-seven years before because of irritation and the fear of sympathetic ophthalmia. His right eye had a circumcorneal injection. There were an arcus senilis and a superficial white opacity 2 mm. from the limbus at 8 o'clock. The anterior chamber was shallow; the iris and the pupillary reactions were normal. The peripheral fields as tested with 1 degree white and red targets were essentially normal. The tension (Schiötz) was 30 mm. of mercury, and the pupil was 3 mm. in diameter. Vision of the right eye was 1.0—1 with a —0.50 D. sphere —0.25 D. cylinder, axis 90. On June 10 the tension was 31 mm. There was an Elschnig type 2 excavation of the disk, the excavation reaching the margin between 10 and 11:30 o'clock, and the slope of the wall was suggestive of a beginning glaucomatous excavation.

After 3 drops of eucatropine was instilled the pupil was 4.5 mm. in diameter, and the tension (Schiötz) 35.5 mm. During the period up to October 14 the patient had attacks of smoky vision, and even when the eye was under the influence of pilocarpine the tension rose to 39 mm. The patient was advised to have an Elliott trephine operation, which was done on October 14.

The anterior chamber was not reformed until the fifth day after the operation. On the eleventh day after the operation detachment was seen in the upper nasal and temporal portions of the choroid. On November 22 the choroidal detachment was still present; the best vision of the right eye was 0.4 — 1 with a — 3.00 D. sphere — 1.0 D. cylinder, axis 180. The anterior chamber was shallow; the bleb was large, and the tension was within normal limits. On November 28 there was practically no change. On December 20 there were a posterior synechia at 11:30 o'clock and pigment on the anterior capsule of the lens. The incipient cataract, the fields and the choroidal detachment were unchanged. The condition remained about the same, vision becoming gradually less and the lenticular changes slightly more dense, but the tension was only 11.5 mm. on April 30, 1934. On that day the patient was admitted to the hospital, and a posterior sclerotomy was done to withdraw the subchoroidal fluid. There was no change in either the tension or the fields, and vision was 0.2 + 1.

On June 12 the tension was lower, and vision was further reduced. The plastic closure of the trephine opening already described was attempted. The patient had a moderate reaction to the operation, and on July 21 vision was 8/200, but the condition was essentially unchanged. On August 18 the choroidal detachment had disappeared, and the peripheral field for form was entirely normal. The filtrating bleb was much smaller; the anterior chamber was deeper, and the lenticular opacities were slightly increased. Vision was 5/200; the tension was 11.5 mm., and the pupil was 3 mm. in diameter.

The chart shows the field for form as tested with a 2 degree target. The field was taken first on Oct. 26, 1933, twelve days after the Elliott trephine operation; it was taken again on June 9, 1934, three days before the plastic operation, and a third time on August 18, two months after the plastic operation.

The lenticular opacities became more dense, and the fields became smaller. On April 18, 1935, a combined extraction of the lens was done through an incision of the inferior limbus. On Jan. 1, 1936, the secondary cataract was needled. The field was taken a fourth time on Jan. 30, 1937, a 2 degree target being used. On that date vision was 0.8—1.

The cornea was clear; the anterior chamber was deep, and the pupil measured 6 by 6.5 mm. and was keyhole shaped. There was an iridectomy wound at the periphery of the iris opposite 12: 30 o'clock. The bleb was cystic and appeared flat. The nasal third of the pupillary space had a dense secondary capsule, but the temporal two thirds were fairly clear. There was a good red reflex. The retina and choroid were in normal position. The disk was pale, and the macula was apparently normal. The tension was 18 mm.

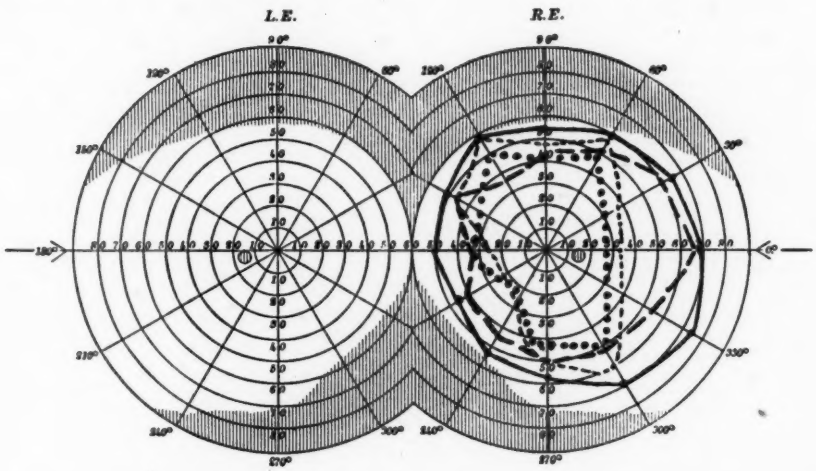

Chart showing the visual field of the right eye on various dates. The line of short dashes indicates the border of the field taken on Oct. 26, 1933, after the trephine operation; the dotted line, the border of the field taken on June 9, 1934, before plastic repair; the unbroken line, the border of the field taken on August 18, after plastic repair, and the line of long dashes, the border of the field taken on Jan. 30, 1937, after extraction of the cataract and needling of the secondary cataract.

SUMMARY

A case of choroidal detachment associated with low tension and constricted fields, which persisted for eight months, is presented. A piece of tendon of the superior rectus muscle was transplanted over the trephine opening, and seven weeks later the choroidal detachment had disappeared and the field was restored to normal.

CONCLUSION

Repair of all choroidal detachments in seeing eyes which persist for three months should be attempted.

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EMBRYOTOXON CORNEAE POSTERIUS AXENFELD

REVIEW OF THE LITERATURE AND REPORT OF A CASE

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In 1920 Axenfeld [1] described a white circular line that he observed on the posterior surface of each cornea, about 1 mm. from the margin, in an otherwise normal person. This he placed in the plane of Descemet's membrane and gave to his finding the name embryotoxon corneae posterius.

There are several earlier reports concerning a similar condition. In 1895 Mager [2] described a ringlike, gray-white opacity 2 mm. in width in the deepest layers of each cornea of a 4½ year old girl.

In 1898 Gloor [3] reported the case of a 6¼ year old girl with many congenital anomalies of the face and extremities. The left eye was normal, but the right cornea showed an opacity 1 mm. in width, near the limbus, extending over two thirds of the cornea. The author did not mention in which layer the opacity appeared, but the drawing showed that it was similar to those described by Axenfeld.

In 1908 Stephenson [4] described the eye of a 5 month old baby with an arcuate light blue strip of tissue which occupied the upper and inner part of the anterior chamber. He stated: "This appears to lie in a plane somewhat anterior to the iris tissue and may even be on the posterior surface of the cornea."

Thier [5] in 1921 added the report of a case of ringlike opacity of Descemet's membrane parallel to the limbus at a distance of one fourth of the radius; otherwise the cornea was clear. The iris was connected with this band.

In 1921 Kayser [6] described two cases of a similar condition. In one the band extended over four fifths of the corneal circumference. In the other case the band was in only the nasal portion. The tissue between the band and the limbus was translucent. No mention was made of iridic bridges.

From the Eye Service, the Mount Sinai Hospital.

1. Axenfeld, T.: Ber. ü. d. Versamml. d. deutsch. ophth. Gesellsch. **42**:301, 1921.
2. Mager, W.: Wien. klin. Wchnschr. **2**:252, 1895.
3. Gloor: Arch. f. Augenh. **37**:159, 1898.
4. Stephenson, S.: Tr. Ophth. Soc. U. Kingdom **28**:100, 1908.
5. Thier: Arch. f. Augenh. **89**:137, 1921.
6. Kayser, B.: Klin. Monatsbl. f. Augenh. **68**:82, 1922.

In 1927 Remky [7] contributed the first findings on slit lamp examination, in another case in which the opacity was characteristic. He found a narrow, gray-white, slightly wavy band on the back of the cornea, 1 mm. from the limbus, in a 23 year old man with traumatic conjunctivitis. It came out of the angle of the anterior chamber at 6 o'clock and disappeared again into the angle at 11 o'clock. It impressed him as a flat, glassy, opaque line of a rather uniform width, situated on the back of the cornea, giving the impression of a continuation of a line beyond the angle of the chamber.

In 1930 Velhagen Jr.[8] reported under the title "Double Gerontoxon" a complete bilateral ring on the back of the cornea of a 70 year old man with arcus senilis. Not mentioning the hitherto described cases, he considered his finding as a second arcus senilis of unusual position. The added description of the picture seen on slit lamp examination seemed to put this anomaly into the group of those cited.

In 1933 Ida Mann [9] gave an extensive report of three cases of a similar condition.

In the first case the opacity was found in the left eye of a young man with a slight injury to the right eye. The center of the cornea was clear, but a semitransparent membrane extended along most of its circumference on the posterior surface.

In the second case the membrane extended around the lower two thirds of the posterior surface of the periphery of the right cornea. Tissue completely covered the posterior surface of the left cornea.

In the third case the band was adherent to the iris through a segment of the circumference.

In 1935 Rieger [10] described the eyes of a 25 year old girl with ectopic pupils and a slight gray band on the back of the periphery of the cornea, and in 1933 Dudinow [11] found on the back of the cornea of the left eye of a 25 year old man a thick membrane extending from 3 to 11 o'clock.

In 1936 Clapp [12] described the first case of this condition reported in this country, in which both eyes of a 36 year old man were affected. The right cornea was clear in its central portion, but around the periphery was a semitransparent clouding. The left cornea was nearly completely opaque, with general opalescence of the stroma and a translucent membrane on its posterior surface. I am able to contribute an additional case of this type of opacity.

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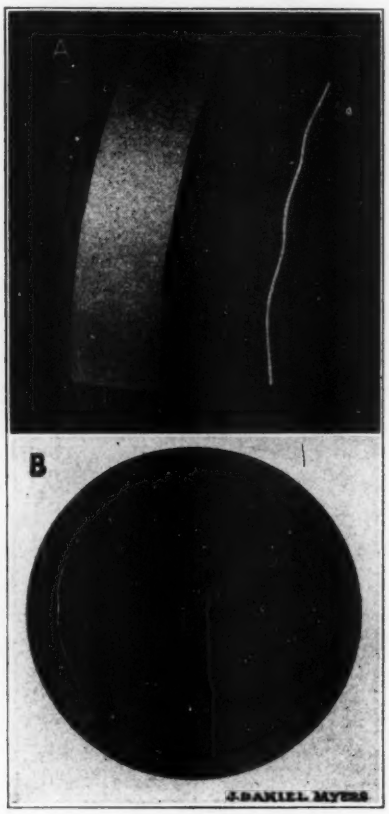
7. Remky: Klin. Monatsbl. f. Augenh. **78**:512, 1927.
8. Velhagen, K., Jr.: Klin. Monatsbl. f. Augenh. **85**:264, 1930.
9. Mann, Ida: Brit. J. Ophth. **17**:449, 1933.
10. Rieger, H.: Arch. f. Ophth. **133**:602, 1935.
11. Dudinow, O. A.: Ztschr. f. Augenh. **81**:336, 1933.
12. Clapp, C. A.: South. M. J. **29**:119, 1936.

REPORT OF CASE

S. A., a 42 year old white man, came to the outpatient department of the Mount Sinai Hospital, complaining of a burning sensation in both eyes. The family history did not reveal any malformations or any hereditary diseases of the eye. The patient had had measles as a child and had frequently suffered from sore throat. For the past six years he had had diabetes. He was married and had two healthy children. The general examination gave negative results. The blood count was normal. Tests of the blood chemistry showed a urea nitrogen



A, slit lamp section through the temporal limbus corneae of the right eye; *B*, front view of the right eye.

content of 8 mg. per hundred cubic centimeters and a sugar content of 210 mg. The blood pressure was 160 systolic and 90 diastolic. Urinalysis showed traces of albumin and a varying amount of sugar. The teeth were normal. The nose and throat were normal. An electrocardiogram suggested hypertrophy of the left ventricle, with probable myocardial involvement.

Ocular Findings.—The palpebral fissures of both eyes were equal. The lids were normal. There was no exophthalmos or enophthalmos. The movements were normal, and there was no nystagmus. The conjunctiva of each eye was slightly injected, but there was no ciliary injection. In the superficial epithelial layers of the right cornea there were three, and in those of the left cornea,

from six to seven, pinhead-sized areas of infiltrates, stainable with fluorescein. The sclerocorneal margin was distinct. There was no arcus senilis. The corneal stroma was clear. On the back of the right cornea, a band 0.75 mm. in width appeared at 8 o'clock, coming from the angle of the anterior chamber and extending in a slightly wavy fashion to 10 o'clock, where it disappeared in the angle of the chamber. It was glassy white and transparent, and in two places there were several fine pigmented spots on each margin. On the back of the left cornea was a similar band, beginning at 7 o'clock and going to 5 o'clock, where it disappeared in the angle, coming out again at 4 o'clock, to disappear at 2 o'clock. The band gave an impression of an empty blood or lymph vessel. The corneal tissue between the band and the limbus was clear. The deep brown iris seemed to be normal. The pupils were round and situated in the center of the iris; they were equal and reacted to light and in accommodation. After instillation of 2 drops of a 4 per cent solution of cocaine hydrochloride they were dilated equally and remained round. The lens was normal. The vitreous was clear. The disk of each eye was normal, but the blood vessels were irregular in caliber, and in the right fundus there were a few scattered small hemorrhages. The tension was normal. The peripheral and central visual fields were normal. Vision was 20/20 in the right eye; it was 20/30 in the left eye, and with correction with a —0.50 diopter sphere equaled 20/20.

COMMENT

The previously described sixteen cases can be divided into three groups: (1) those in which there was a complete ring on the posterior surface of the cornea at some distance from, and parallel to, the limbus; (2) those in which there was a partial band, in which possibly the rest of the complete ring was invisible behind the limbus; (3) those in which there was a broad band of tissue, without free space between the limbus and the band, or a network formation on the back of the cornea.

In all these groups there may be hypoplasia or anomalies of the iris, or more or less fine connections between the iris and the band.

The case reported by me fits into group 2. The name which Axenfeld gave to this finding may be a misnomer. Embryotoxon is generally defined as a congenital opacity of the periphery of the cornea. The normal sharp demarcation between the cornea and the sclera is missing.

Peters [13] in 1909 stated that he considered this type of opacity the most frequent congenital anomaly of the cornea. He observed it histologically to be an overlapping of the cornea by scleral tissue. In the later textbooks it seems to be regarded as identical with arcus juvenilis, in which clear corneal tissue lies between the sclera and the opacity, and hence is but an early acquired gerontoxon, or arcus senilis. In spite of these objections, it seems practical to continue to use Axenfeld's terminology.

13. Peters, A.: Die angeborenen Fehler und Erkrankungen des Auges, Bonn, F. Cohen, 1909.

As to the etiology, the opinions of the authors are widely divergent.

Velhagen Jr.[8] explained the formation of the ringlike opacity as a colloid chemical phenomenon, the so-called Liesegang's ring.

Clapp [12] considered low grade intra-uterine inflammation as the most satisfactory explanation. In his case the picture was apparently complicated through previous interstitial keratitis, at least in one eye.

Most of the authors agree that the band is a congenital anomaly.

Axenfeld [1] expressed the belief that the opacity is either a ligamentum pectinatum which does not exist normally in man or that it represents incomplete separation of the iris and the cornea.

Ida Mann [9] mentioned the possibility of an increase of the amount and untoward persistence of postendothelial tissue which forms the anlage of the pupillary membrane and the anterior layer of the iris. The origin of this band from mesodermal tissue seems to be certain. The fine connections with the iris and the spots of pigment on each side indicate that this is the case. The similarity to an empty blood or lymph vessel in the case described by me and, probably, in some of the cases formerly reported suggests another explanation.

Schlemm's canal seldom consists of a single lumen; generally there are several in this canal. I suggest, therefore, the possibility that the so-called embryotoxon corneae posterius on the posterior surface of the cornea is nothing else than an atypically located branch of Schlemm's canal. I could not see any blood cells in the one I observed, but the general condition of the patient, who was diabetic, made experiments to produce venous stasis inadvisable.

RETINAL DETACHMENT DUE TO ALLERGY

REPORT OF A CASE

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C. B., a man aged 62, wearing a corrective lens for high myopia and astigmatism (a —6.00 D. sph. —4.00 D. cyl., ax. 70), came to my office in September 1932 with the complaint of blurred vision in the left eye. He had some nodular swellings on his body which he said were caused by eating certain food. Examination of the eyeground showed considerable opacity of the lens and what appeared to be corrugation on the fundus. The blood vessels appeared to be curving and dipping. The patient was told that the fundus had the appearance of beginning retinal detachment. He was put flat on his back and blindfolded for two weeks. As a result the fundus regained its normal appearance, and vision returned to normal.

During the Christmas holidays, three months later, when the patient was eating more than usual, he had nodular swellings on his body and partial loss of vision in his left eye again. Examination of the fundus at this time showed a large detachment in both upper quadrants, which gradually increased until within two days the optic nerve head could not be distinguished. The patient was put on his back and blindfolded for three weeks, but the fundus did not fall back in place as on the previous occasion. He was seen later by a consultant, who felt that the detachment was so great that operation was inadvisable. The patient gave a history of having bumped his head on a door several days previous to this loss of vision, but he felt that it was not the cause of his trouble. This, of course, is questionable.

Four months later, in May 1933, vision of the right eye became blurred, being reduced to 20/100. Five weeks before this vision had been 20/30 with correction, in spite of the opacities of the lens. The fundus was examined, and a corrugated appearance was noted similar to that previously observed in the left eye. The patient was put to bed for two weeks, during which time vision returned to 20/25, and he was able to read Jaeger's test type no. 1.

The patient was seen August 20, four months later; vision of the right eye was found to be 20/25, and he could read Jaeger's test type no. 1 with this eye. Ten days later he returned with the complaint of blurred vision again; swellings on various parts of the body were present simultaneously. Vision of the right eye at this time was reduced to 20/70, with equal impairment for reading. Corrugation again appeared on the fundus, which cleared up with rest in bed and dietary restrictions.

An allergic history of urticaria and nodules on the body, which were at this time associated with the corrugated appearance of the fundus and blurring of the margins of the optic nerve, suggested that his sudden loss of vision might be on an allergic basis.

However, in the following October, because the patient felt that his general condition was good and because the opacities of the lens were increasing in the right eye, the vision of which he was anxious to save, he consented to extraction of cataract. The lens was removed successfully by the intracapsular method.

Vision was 20/30, and he could read Jaeger's test type no. 1 with correction. He progressed well for two months, but in the next three months suffered some impairment of vision, with edema of the optic nerve head and retina. Scopolamine, ethylmorphine hydrochloride and foreign proteins proved of no avail. He was sensitive to atropine.

Vision of the right eye remained about the same (20/100) during the months following, until September 1934. At this time a large retinal detachment developed in the right eye. There was no history of trauma, but the detachment was associated with allergic nodular swellings on various parts of the body.

The patient's history showed the usual diseases of childhood: whooping cough, mumps and measles, two severe attacks of rheumatism, at the ages of 10 and 30 years, and frequent attacks of tonsillitis and infections of the upper respiratory tract. His tonsils were still present. He underwent a prostatectomy in 1930.

He reported having been afflicted several times in his youth with the hives, usually with some accompanying gastric distress. In 1917 and 1918 this allergic disturbance reappeared in the form of nodules and edematous areas, which occurred most often on the back of his neck and behind his ears. Less frequently they appeared on his back, feet, forearms and hands. The patient discovered at this

A and *B*, side and front views of the patient, showing swelling; *C*, appearance of the patient three days later.

time that the ingestion of beans, which he liked and ate frequently, produced marked swellings and gastric discomfort.

At the time of the operation for cataract intradermal allergic tests were made. These showed the following sensitivities: two plus reactions to currant, apple, pear, dill, hops, paprika, black pepper, pimento, sage, vanilla and Fleischmann's yeast; one plus reactions to egg yolk, onion, garlic, banana, ginger, buckwheat, pecan, spinach, beet, horseradish, blackberry, raspberry, strawberry, almond, cherry, lima bean, string bean, peanut, parsnip, parsley, celery, coffee, pumpkin, squash, mushroom, nutmeg, red and green pepper, canary feathers, chicken feathers, goose feathers, duck feathers, cat hair, cattle hair, dog hair, hog hair, horse dander, rabbit hair, sheep wool, orris root, silk and tobacco.

The tests were repeated in June 1934. The following reactions were obtained: four plus reactions to house dust, duck feathers and goose feathers; three plus reactions to orris root; two plus reactions to apple, rye, coffee, chicken feathers, cat hair, horse dander, rabbit hair, sheep wool, kapok, pyrethrum and tobacco; one plus reactions to onion, wheat, lima bean, string bean, cocoa, peach, squash, black pepper, dog hair, cattle hair, goat hair, and cottonseed; plus-minus reactions to grapefruit, potato, peanut and Fleischmann's yeast.

Since that time the patient has been on a diet free from the offending allergens and has had only one serious flareup. This followed a Thanksgiving dinner in 1935, at which time he ate turkey liver. He stated that it tasted unpleasant to

him and caused some gastric distress. The next day he appeared with marked edema of the jaws and cheeks, the greatest reaction he ever had. At the same time blebs developed on the cornea of the left eye, some of which were 3 or 4 mm. in diameter. These gradually disappeared as the swelling of the jaw and lips receded.

The patient had not been tested for sensitivity to turkey liver, but an intradermal test for sensitivity to beef liver was negative. This test has been repeated since, with the same result. The patient had been eating beef liver about two times a week because of an anemic condition, and experiment showed him that some allergic reaction was produced each time he ate it. He was advised to omit liver from his diet and to discontinue the use of cod liver oil in various forms and the halibut liver malt which he had been taking daily as a general tonic. The long-continued absorption of liver preparations may account in some measure for the apparent sensitivity he acquired for liver.

COMMENT AND CONCLUSIONS

The sudden loss of vision and the appearance of corrugations on the fundus associated with nodular swellings on the body, which recurred on numerous occasions before the retina became completely detached, seem to indicate that the pathologic condition in this particular case might have been on an allergic basis.

The appearance of blebs on the cornea coincident with a severe allergic reaction and their simultaneous subsidence seem to indicate that allergic reactions may become localized on or within the eyeball.

Intradermal tests repeatedly failed to show sensitivity to liver, although a reaction in the patient in the form of nodular swellings could be produced by eating it. The patient improved clinically after being on an allergic diet.

The patient has been followed since the fall of 1932, and the case is reported as one in which nodular swellings due to allergic reactions might be present on the cornea and behind the retina and be the specific factor causing retinal detachment.

EFFECT OF CYSTEINE HYDROCHLORIDE ON THE CONJUNCTIVA

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Wherever there are areas of increased proliferation of cells, the concentration of the SH, or sulfhydryl, group is increased. Thus in tumor tissue the concentration of glutathione is high, as shown by Voegtlin and Thompson,[1] Lecloux, Vivario and Firket [2] and Baker.[3] Hammett [4] demonstrated that additions of sulfhydryl substances increased the proliferation of certain roots. According to Hammett and Reimann,[5] proliferation of cells in the skin is accelerated by means of wet dressings containing compounds of sulfhydryl. Lebensohn,[6] who used thiocresol in traumatic corneal ulcers in rabbits, found that epithelialization occurred so rapidly normally that a comparison could not be made.

This report is concerned with the effect of cysteine hydrochloride [6a] on the eye of rabbits and the clinical application suggested from the results. Powdered cysteine hydrochloride was dusted into the conjunctival sac of rabbits daily. This produced reddening of the conjunctiva and superficial abrasion of the cornea, which cleared up in the course of several hours. (The cysteine applied in the form of a paste consisting of equal parts of the powder and water did not cause any denudation of the epithelium.) After three weeks and again after six weeks, parts of the conjunctiva (tarsal and bulbar) and cornea were prepared for microscopic examination.

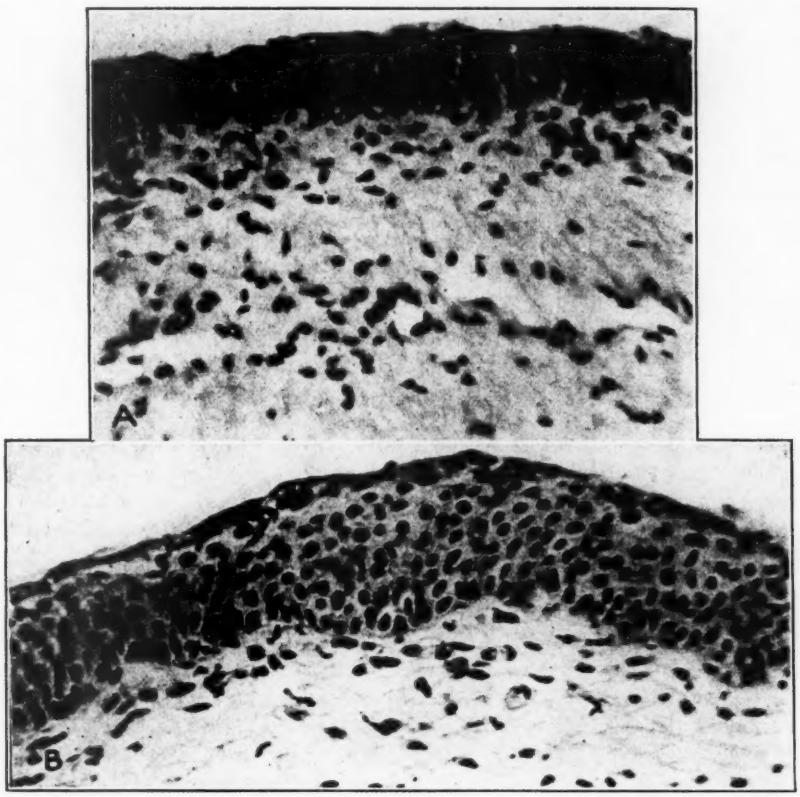
The tarsal conjunctiva, after three weeks of the application of the cysteine hydrochloride, when examined microscopically showed, instead of the ordinary three or four layers of epithelium, five or six layers. The outer two or three layers consisted of smaller cells with dark nuclei. The sections of the tarsal conjunctiva after six weeks of treatment with the sulfhydryl revealed on examination from nine to twelve layers of cells. The cells appeared larger than the normal cells of the control

1. Voegtlin, C., and Thompson, J. W.: J. Biol. Chem. **70**:801, 1926.
2. Lecloux, J.; Vivario, R., and Firket, J.: Compt. rend. Soc. de biol. **97**: 1823, 1927.
3. Baker, L. E.: J. Exper. Med. **49**:163, 1929.
4. Hammett, F. S.: Protoplasma **7**:20, 1929.
5. Hammett, F. S., and Reimann, S. P.: J. Exper. Med. **50**:445, 1929.
6. Lebensohn, James: Unpublished experiment.

6a. E. R. Squibb & Sons supplied the chemical.

eye, and the nuclei did not stain as deeply as those in the latter. Scattered throughout the epithelium an occasional polymorphonuclear cell was seen, but microscopic examination showed no evidence of inflammation. The epithelium of the cornea was unchanged.

The ability to increase the thickness of the palpebral conjunctiva (at will) may be of value clinically, for it is well known that thick mature mucous membranes (oral mucous membrane and vaginal



A, normal palpebral conjunctiva of the rabbit; *B*, palpebral conjunctiva after treatment with cysteine hydrochloride.

mucous membrane of the adult) are very resistant to the gonococcus. Thus, as was first shown by Lewis [7] and confirmed by others, gonorrheal vaginitis in infants is improved greatly by producing maturation and thickening of the vaginal epithelium by means of theelin. It seems plausible that similar thickening of the palpebral conjunctiva may be of value in treating gonorrheal ophthalmia. In cases in which the condition is unilateral the application of cysteine hydrochloride to the uninvolved conjunctiva for prophylaxis might be considered.

Prof. S. R. Gifford and Dr. I. Puntenney gave help and criticism in this study.

7. Lewis, R. M.: Am. J. Obst. & Gynec. **29**:806, 1935.

HUMAN AUTONOMIC PHARMACOLOGY

IX. EFFECT OF CHOLINERGIC AND ADRENERGIC DRUGS ON THE EYE

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AND
WILLIAM THAU, M.D.
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In a comprehensive plan of study of the reactions of the organs of the human body to mecholyl (acetylbetamethylcholine hydrochloride), prostigmin (the dimethylcarbamic ester of 3-hydroxyphenyltrimethylammonium methylsulfate), benzedrine (benzylmethylcarbinamine or betaphenylisopropylamine) and atropine (the mandelic ester of atropine) a series of experiments were carried out on the eye. The plan of research was that which has been used in this laboratory in studies on sweating, flushing, lacrimation, gastro-intestinal motility, gastric juices, the heart, the pulse rate, the blood pressure and the urinary bladder.[1]

Read before the New England Ophthalmological Society, Feb. 16, 1937.

From the Division of Psychiatric Research, the Boston State Hospital, Mattapan, Mass.

This study was aided by grants from the Commonwealth of Massachusetts and the Rockefeller Foundation.

1. Myerson, A., and Ritvo, M.: Benzedrine Sulfate and Its Value in Spasm of the Gastro-Intestinal Tract, J. A. M. A. **107**:24-26 (July 4) 1936. Myerson, A.; Loman, J., and Dameshek, W.: Physiologic Effects of Benzedrine and Its Relationship to Other Drugs Affecting the Autonomic Nervous System, Am. J. M. Sc. **192**:560-574 (Oct.) 1936. Myerson, A.; Rinkel, M., and Dameshek, W.: The Autonomic Pharmacology of the Gastric Juices, New England J. Med. **215**:1005-1013 (Nov. 26) 1936. Myerson, A.; Loman, J., and Dameshek, W.: Physiologic Effects of Acetyl-Beta-Methylcholine (Mecholyl) and Its Relationship to Other Drugs Affecting the Autonomic Nervous System, Am. J. M. Sc. **193**:198-214 (Feb.) 1937. Myerson, A.; Loman, J., and Rinkel, M.: Human Autonomic Pharmacology: VI. General and Local Sweating Produced by Acetyl-Beta-Methylcholine Chloride (Mecholyl), Am. J. M. Sc., to be published. Myerson, A.; Schube, P. G., and Ritvo, M.: The Effect of Acetyl-Beta-Methylcholine (Mecholyl) on the Atonic Colon, Radiology **28**:552-558 (May) 1937. Schube, P. G.; Ritvo, M.; Myerson, A., and Lambert, R.: Human Autonomic Pharmacology: IV. The Effect of Benzedrine Sulfate on the Gall-Bladder, New England J. Med. **216**:694-697 (April 22) 1937. Dameshek, W.; Loman J., and Myerson, A.: Human Autonomic Pharmacology: VII. The Effect on the Normal Cardiovascular System of Certain Sympathomimetic and Parasympathomimetic Drugs—Acetyl-Beta-Methylcholine Chloride, Atropin, Prostigmin, Benzedrine, with Especial Reference to the Electrocardiogram, to be published. Myerson, A.; Rinkel, M.; Loman, J., and Myerson, P.: Human Autonomic Pharmacology: X. The Synergism of Prostigmin and Mecholyl, J. Pharmacol. & Exper. Therap., to be published.

In the working hypothesis (illustrated in fig. 1) we accepted the theory of chemical mediation, which is as follows: (*a*) Acetylcholine is somehow manufactured at the interneuronic synapses of both the sympathetic and the parasympathetic system. (*b*) Acetylcholine is also manufactured at the junction of the second parasympathetic neuron and the reacting cell and brings about whatever activity stimulation of the parasympathetic nervous system produces. (*c*) This chemical activity is carried on in intimate relationship to choline esterase, the mechanism of production of which is unknown, but which seems to be present throughout the tissues of the body. This esterase has the property of entering into chemical union with acetylcholine and thus destroying its effectivity, probably by hydrolysis of the ester radical. The esterases thus bring about an intermittency of activity of acetylcholine. (*d*)

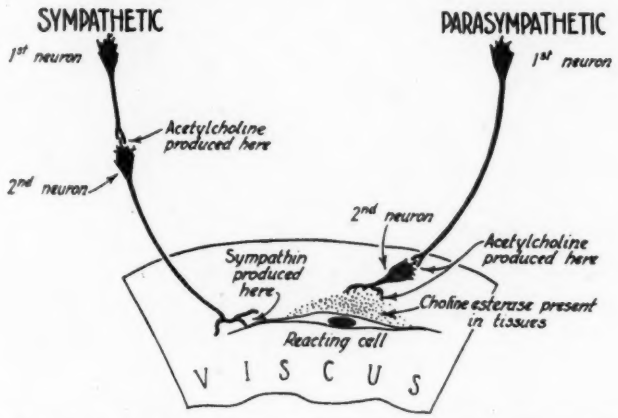

Fig. 1.—Schema of balance between sympathetic and parasympathetic nerves and esterase.

In the sympathetic system, at the junction of the second sympathetic neuron with the reacting cell, a substance akin to epinephrine is produced, called by Cannon sympathin E. This substance produces the effects of stimulation of the sympathetic nervous system.

The working hypothesis may be linked up with the four drugs with which we have experimented as follows (fig. 2):

1. Mecholyl in the main produces the same effects as acetylcholine, although it is much more powerful. The effects of acetylcholine itself on man are difficult to obtain experimentally and with safety.

2. Prostigmin, when given in advance of mecholyl or with it, destroys or inhibits the esterases and, consequently, is a marked synergist of mecholyl.

3. Atropine, when given in advance of mecholyl or during the time of the effects of the latter, abolishes or prevents those effects. Atropine probably does not act on nerve fibers such as the vagus nerve, but

directly changes the chemical reactions which take place between the reacting cell and acetylcholine, so that the effects of acetylcholine are warded off or abolished (Loewi [2]).

4. The other studies of this laboratory have demonstrated further that benzedrine, the effects of which show some divergences from the effects of epinephrine, is mainly adrenergic and that whatever adrenergic effects may take place, such as those of the action of the heart, the blood pressure, the gastro-intestinal motility, and the gastric juices, benzedrine tends to bring them about. Atropine acts as a synergist of benzedrine or of any adrenergic drug by removing the acetylcholine brake or check upon adrenergic activity. Thus, the synergism of benzedrine and atropine differs from that of mecholyl and prostigmin in that the latter synergism is a direct enhancement of effect in the same direction,

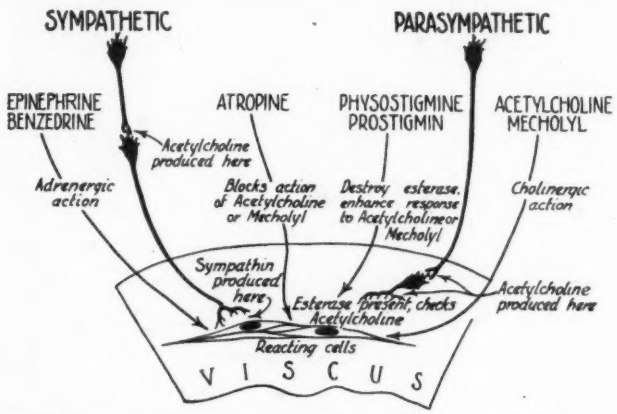

Fig. 2.—Chart illustrating the chemical reactions of mecholyl, prostigmin, atropine and benzedrine.

whereas in the case of the former synergism the parasympathetic brake on adrenergic activities is removed.

HISTORY

The most comprehensive general articles on the autonomic pharmacology of the eye are those by Velhagen.[3] His researches have demonstrated the presence of active chemical substances in the eye, and

2. Loewi, O., and Navratil, E.: Humoral Transmission of Nerve Stimuli: Mechanism of Vagal Action of Physostigmine and Ergotamine, Arch. f. d. ges. Physiol. **214**:689-696, 1926.

3. Velhagen, K., Jr.: Choline Acetylcholine as Physiologic Components of Retinal and Uveal Tissue, Arch. f. Augenh. **105**:573-602, 1932; The Action of the Cholines on the Muscles of the Iris, with Special Reference to Their Double Innervation, ibid. **108**:126-136, 1933; Further Experiments on Active Principles in the Ocular Tissues, ibid. **109**:195-204, 1935.

especially he has shown that there is present both in the aqueous and in the tissues of the iris a substance which in all its reactions corresponds to acetylcholine. This substance is also present in the retina. He stated that acetylcholine and carbaminocholine activate the sphincter of the isolated iris even after atropinization, and the results of these experiments lend support to his theory of double innervation of the sphincter muscle of the iris by sympathetic and parasympathetic fibers, although the dilator muscle is entirely innervated by sympathetic fibers.[4] These drugs act directly on the muscle, which is in line with the results of experiments carried out by many investigators on isolated preparations of muscle elsewhere in the body.[5] The papers reporting their studies should be read in the original because of the scholarly and thorough survey of the literature. Velhagen also pointed out that accumulation of the esterases is a factor in pathologic conditions of the eye, a point which will be considered later as we discuss our own experiments.

Engelhart [6] did not find acetylcholine in the aqueous of the rabbit and cat. He performed, however, a rather critical experiment: If one eye is illuminated and the other kept in the dark, a large amount of the vagus substance, acetylcholine, is found in the illuminated eye, and practically none is found in the dark-adapted eye; a considerable quantity is found in the ciliary body and iris, and this amount is increased by electrical stimulation of the third nerve. Following section and degeneration of the third nerve, the vagus substance vanishes completely from the ciliary body and iris. The importance of Engelhart's experiment lies in the fact that the results showed that light thus acts to produce acetylcholine and that the mechanism is a local one.

Much therapeutic work has been done with acetylcholine in diseases of the eye. Thus, Santonastaso [7] voiced the belief that acetylcholine relaxes the accommodation spasm which reduces distant vision in myopes.

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4. This is not in accord with the results of studies on man.

5. Morison, R. S., and Rosenblueth, A.: The Action of Eserine and Prostigmin on Skeletal Muscle, Science **84**:551-552 (Dec. 18) 1936. Briscoe, G.: The Antagonism Between Curarine and Acetylcholine, J. Physiol. **87**:425-428, 1936. Brown, G. L.; Dale, H. H., and Feldberg, W.: Reaction of the Normal Mammalian Muscle to Acetylcholine and to Eserine, ibid. **87**:394-424, 1936. Rosenblueth, A., and Cannon, W. B.: The Adequacy of the Chemical Theory of Smooth Muscle Excitation, Am. J. Physiol. **116**:414-429, 1936.

6. Engelhart, E.: The Humoral Mechanism of Stimulation of the Third Nerve, Arch. f. d. ges. Physiol. **227**:220-234, 1931.

7. Santonastaso, A.: The Influence of Acetylcholine on Accommodative Spasm, Ann. di ottal. e clin. ocul. **61**:881-889 (Dec.) 1933.

One-tenth gram injected subcutaneously for from six to eight days seems to produce this result, but apparently the most important result is that the near point recedes 1 to 3 cm. It is difficult to account for this result in view of the fact that in hyperopia the near point diminished 24 cm. in one case.

Several other authors have studied the effect of acetylcholine in ametropia and aphakia. The effect of acetylcholine in improving the vision in myopia is believed by Possenti [8] to be due to relaxation of the ciliary muscle, which improvement is in part attributed to the vasodilatation affecting the retinal vessels and hence improving the retinal function.

Acetylcholine has been used in a variety of conditions, mainly arterial in nature—embolism of the retinal artery,[9] blindness due to hemorrhage,[10] quinine amblyopia and amaurosis [11] and homonymous hemianopia of the migraine type [12]—and for its effect on the visual field in diseases of the optic nerve.[13] The intra-ocular pressure, especially in glaucoma, has been studied.[14] Several papers have appeared on the use

8. Possenti, G.: Effect of Acetylcholine in Emmetropia, Ametropia and Aphakia, Ann. di ottal. e clin. ocul. **62**:529-572 (July) 1934.

9. Orr, H. C., and Young, J. H.: Acetylcholine in Embolism of the Retinal Artery, Brit. M. J. **1**:1119-1120 (June 1) 1935.

10. Hartmann, E., and Parfonry, J.: Blindness Due to Hemorrhage Cured by Acetylcholine, Bull. Soc. d'opht. de Paris, February 1934, pp. 56-61.

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14. Rycroft, B. W.: The Vascular Control of the Intraocular Pressure: Some Experimental Observations, Tr. Ophth. Soc. U. Kingdom **54**:315-326, 1934. Porhoryles, G.: The Action of Acetylcholine upon the Pressure in the Retinal Vessels, Rassegna ital. d'ottal. **3**:794-805 (Sept.-Oct.) 1934. Villaret, M.; Justin-Besançon, L., and Gallois, J.: The Action of Alpha Methyl-Acetylcholine on the Iris and on Ocular Tension, Bull. et mém. Soc. franç. d'opht. **44**:532-536. Galeazzi, C.: The Action of an Ester of Choline, Carbaminoylcholine, in Normal and Pathologic Eyes, Boll. d'ocul. **13**:1443-1460 (Nov.) 1934. Hartmann, E.: Beneficial Effects of Acetylcholine in Ophthalmologic Practice: Five Cases, Bull. Soc. d'opht. de Paris, June 1933, pp. 414-429. Rossi, V.: Action of Some Derivatives of Choline on the Normal and the Pathologic Eye, Arch. di ottal. **38**:573-585 (Nov.) 1931. Uriarte, A. B.: A New Theory of the Pathogenesis of the Argyll Robertson Sign: Relation to Pupillary Movements, Ann. d'ocul. **172**:672-687 (Aug.) 1935.

of carbaminoylcholine.[15] This drug, according to Velhagen, has the same general effect as physostigmine in lowering the intra-ocular tension and in producing miosis. Acetylcholine has also been used in ophthalmic migraine, with good results, according to Dejean.[16]

MATERIAL

Experiments carried out at the Boston State Hospital, mainly on patients with dementia praecox who were physiologically healthy, and in part on normal persons, showed results which closely correspond to what was expected. The functions of the eye which were studied were: (1) the size of the pupil, (2) the pupillary reaction to light,[17] (3) the pupillary reaction to accommodation, (4) the accommodation of the lens, (5) the intra-ocular tension, (6) the width of the palpebral fissure and (7) the retinal vessels.

1. *Mecholyl.*—The concentration of mecholyl necessary to bring about results on the eye varies from patient to patient remarkably, although this is true of the autonomic pharmacology of man in general. It is perfectly safe to give a 10 to 20 per cent solution. The latter dose will bring about the full effects in any eye, so far as our experiments showed. In some persons a 1 per cent solution will work adequately. It is impossible to predict in advance, so far as our work revealed, what the sensitivity of the individual eye will be. Starting with an average dilatation of from 6 to 7 mm. in diameter, the pupil becomes the size of a pinpoint in twenty minutes, if a sufficient concentration is given.

15. Wilenkin, M.: Effect of Carbaminoylcholine on Intra-Ocular Pressure and on Width of Pupil, Klin. Monatsbl. f. Augenh. **96**:84-90 (Jan.) 1936. Villaret, M.; Justin-Besançon, L.; Schiff-Wertheimer, and Gallois, J.: The Esters of Choline in Ophthalmology, Arch. d'opht. **49**:129-165 (March) 1932. Velhagen, K.: The Ocular Pharmacology and Toxicology of Carbaminoylcholine, Arch. f. Augenh. **107**:319-344, 1933; The Clinical Use of the New Miotic Carbaminoylcholine in the Treatment of Glaucoma, Klin. Monatsbl. f. Augenh. **92**:472-483 (April) 1934. Miloro, A.: The Effect of Doryl in the Treatment of Glaucoma, Ann. di ottal. e clin. ocul. **63**:780-793 (Oct.) 1935.

16. Dejean, C.: Acetylcholine in Ophthalmic Migraine, Presse méd. **40**:1950-1951 (Dec. 24) 1932.

17. In this paper the classic theory of the light reflex is accepted, namely, that it is mediated by light falling on the retina, and the nervous stimulation thus set up travels until it finally reaches the nucleus of the oculomotor nerve, passing along this pathway to the ciliary ganglion, from which the stimulus is carried to the iris and brings about a contraction. An important paper of Uriarte's (A New Theory of the Pathogenesis of the Argyll Robertson Sign: Relation to Pupillary Movements, Ann. d'ocul. **172**:672-687 [Aug.] 1935), in which he built up the hypothesis of the sympathetic reflex to light, or, rather, to darkness, as more primitive and important, is in line with some work which we have done on the Argyll Robertson pupil. The classic theory does not correspond to the clinical fact, but for the moment we accept it as relevant to our experiments.

The preliminary effect is to dilate the superficial vessels and also the retinal vessels. The eye becomes somewhat watery. These effects disappear in one-half hour. There is no pain. The full effects of mecholyl may be summarized thus: (*a*) The pupil becomes the size of a pinpoint. (*b*) The reaction to light is preserved up to the time when the pupil becomes the size of a pinpoint. This is also true of the consensual reaction to light. (*c*) The accommodation reflex of the pupil is also maintained in a similar way. (*d*) The intra-ocular tension drops in the normal eye from 3 to 5 mm., according to the tests carried out with the Schiötz tonometer. (*e*) The fissure becomes definitely narrowed. (*f*) The retinal vessels, arteries and veins dilate.

Accommodation of the Lens: Invariably with sufficient doses the near point diminished, and the ability to read at that point improved. This was especially marked in the presbyopic patients. In several of the patients who were unable to give an exact account of their reactions, it was obvious that the ability to focus on near objects was definitely improved. Thus, one person was unable to read any of the lines on the Jaeger test type card. After mecholyl was given, he was able to read, although with difficulty, the words on any of the lines on the card. The improvement is not associated with a sense of clearness or ease; that is, although through the action of the ciliary muscle the lens apparently is capable of increasing its convexity, that increase is not spontaneously or easily brought about.

Relationship of Effect of Mecholyl with That of Atropine: Atropine sulfate, when instilled in advance of mecholyl, entirely prevents the action of the latter. This is in harmony with work done on the blood pressure, sweating, the gastro-intestinal motility and the gastric secretions. If atropine sulfate is administered at the height of the reaction to mecholyl, the effects of mecholyl cease and are displaced by the effects of atropine within a few minutes. If atropine sulfate is given in advance of mecholyl, the latter, when instilled in the eye, produces no results the first day. On the second day the effect of mecholyl is contraction of the pupil, but this effect disappears rapidly and is replaced by the effect of atropine. On the third day the effects of mecholyl persist for a longer period, but when these disappear the effects of atropine still are partly present. On the fourth day the effects of mecholyl are normal.

2. *Prostigmin.*—A 1 per cent solution of prostigmin is the minimum dilution which we have found to be effective in producing constriction of the pupils. An optimum concentration is about a 5 per cent solution. A 10 per cent solution does not do any damage to the eye. There is some subjective stickiness of the lids for a short time. The vessels do not dilate to the extent that they do when mecholyl is instilled. The pupillary response is not so prompt, but is complete, and the reactions

resemble those of mecholyl closely. In other words, one would be willing to state on the basis of the theory here postulated that enough acetylcholine is constantly manufactured in the eye so that when the esterases are removed by prostigmin the effects of acetylcholine are produced. The intra-ocular tension diminishes according to the concentration of prostigmin given. A 1 per cent solution causes practically no effect. With a 5 per cent solution a marked effect is obtained; that is, in the normal eye the reduction of the tension is from 3 to 5 mm. The decrease lasts from two to three hours or more, there being a gradual return to the normal. This follows the pupillary change. The effect on accommodation is marked, especially in presbyopic patients. We cite the following case as illustrative of this:

The patient was A. M., a man 55 years of age.

1. Normal Condition of the Eyes Without Prostigmin: The pupils were about 3 mm. in diameter and reacted well. Vision of the right eye was 20/30, and with a + 1.25 D. sph. —37 D. cyl., ax. 15, was 20/20. Tests for accommodation showed that without correction for distant vision the patient could not read even large type, such as Jaeger's test type no. 6 and no. 7, at 12 to 15 inches (30.5 to 38 cm.) with either eye. With correction for distant vision he could read Jaeger's test type no. 6 at 12 inches with each eye. With additional correction for the presbyopia (a + 2.50 D. sph.) he could read Jaeger's test type no. 1 at 6 inches (15 cm.).

2. Condition of the Eyes with Prostigmin: The right pupil was practically the size of a pinpoint. The left pupil was not so small (a smaller amount of prostigmin was instilled into the left eye), measuring about 1 mm. in diameter. There was no reaction in either pupil.

Vision of the right eye was 20/20, and with a + 1.25 D. sph. —50 D. cyl., ax. 90, was increased to 20/15. Vision of the left eye was 20/30, and with a + 1.50 D. sph. —50 D. cyl., ax. 90, was 20/20 +. Without a glass the patient could read Jaeger's test type no. 2 at 10 inches (25 cm.) with the right eye and Jaeger's test type no. 4 at a distance of 12 inches with the left eye. With correction for distant vision he could read Jaeger's test type no. 1 at 10 inches with the right eye and Jaeger's test type no. 2 at 12 inches with the left eye.

It will thus be seen that in the right eye, which was fully prostigminized, the accommodation of the lens for the near point increased from 4 to 5 diopters and that in the left eye, from 3 to 4 D. The effect started with blurring for distant vision, so that for a short time the subject was near-sighted. There was some headache at this time. Later on, the headache disappeared, and for several hours the subject was able to read without glasses. The next morning there was some increase in the capacity to accommodate, but this was not sufficient to allow him to dispense with glasses.

In another presbyopic patient, previously mentioned in the section on mecholyl, who was unable to give a complete account of his reactions, there was marked improvement, as evidenced by the fact that he could read all the lines on the Jaeger test type card.

Synergism of Mecholyl and Prostigmin: This is definite and marked. A subminimal dose of mecholyl (a 1 per cent solution) given to a person in whom this produces no result plus a subminimal dose or

concentration of prostigmin (a 1 per cent solution) produces a marked result, with complete miosis, a definite reduction in the intra-ocular tension and increased ability for accommodation.

3. *Benzedrine Sulfate.*—The instillation of a 0.125 to 1 per cent solution of this drug is necessary to produce characteristic effects. In this instance, as in others, no prediction can be made in advance as to the sensitivity of the subject. The effect is characteristic. There is a slight reduction in the sensitivity of the cornea. There is a moderate injection, which lasts for a few minutes. The pupil dilates to the point of complete mydriasis in from fifteen minutes to one-half hour, the dilatation varying with the amount of the drug given and the concentration. With dilute solutions the reaction of the pupil to light becomes diminished, and this diminution of reaction becomes more evident as the solution of benzedrine sulfate is made more concentrated, so that if a solution of 10 per cent is given the reaction to flash-light practically disappears. However, the reaction to daylight still remains, in counter-distinction to the effect of atropine.

At this point we wish to make note of an extraordinary effect on the Argyll Robertson pupil. When a dilute solution of benzedrine sulfate (a 0.125 to 0.5 per cent solution) is instilled into the eye, the Argyll Robertson pupil enlarges, and the reaction to light reappears; that is to say, such a pupil, which does not react to light, which reacts to accommodation and which is miotic, dilates after the instillation of benzedrine sulfate, enlarges in darkness and contracts with difficulty in reaction to flash-light, but easily, although gradually, in reaction to daylight, so that while it is not normal in the rapidity of its response, it corresponds to the normal in the quality of its response. This subject will be taken up in a separate paper. In a certain sense it confirms Uriarte's conclusions about the Argyll Robertson pupil.

The pupillary reaction to accommodation is likewise impaired after the instillation of benzedrine sulfate, and in this respect the effects of the drug closely resemble those of atropine. In dilute solutions the reaction of the pupil to accommodation is retained.

Accommodation of the Lens: In the younger patient the capacity to focus on the near point was greatly diminished, while distant vision remained without any definite change, so far as our tests showed. Clearness of vision was greatly impaired at all points. In the case of the presbyopic patient A. M., near vision entirely and rapidly disappeared, while distant vision, although not clear, was not greatly changed.

Before any change takes place in the pupil, the palpebral fissure becomes definitely widened. This effect is constant when benzedrine sulfate is given and appears even when very dilute solutions, such as a 0.125 per cent solution, are used. Benzedrine, like epinephrine and cocaine, by its local stimulation of Müller's fibers, widens the fissure and thus

causes the appearance of exophthalmos. This effect is regularly produced and takes place often before the pupil dilates. While one often gets the appearance of exophthalmos, careful studies carried out for us by Dr. Benjamin Sachs with the exophthalmometer showed that there is no true exophthalmos and that its appearance is an illusion created by the enlarged pupil and the widened fissure. Similarly, there is no enophthalmos created by mecholyl, although the fissure narrows and the pupil becomes smaller. The appearance of enophthalmos is striking, but, as has already been mentioned, the measurements carried out by Dr. Sachs failed to show any.

The intra-ocular tension is increased from 2 to 4 mm., according to the concentration.

In Combination with Atropine: The synergistic effect of atropine and benzedrine showed up strikingly in our experiments. A markedly subminimal dose of atropine sulfate (a 1:2,000 solution), used together with a 1:1,000 solution of benzedrine sulfate, within a few minutes produces marked dilatation of the pupil, which is reactionless to light and accommodation. The accommodation of the lens disappears. The intra-ocular tension is only slightly increased.

4. *Atropine Sulfate.*—The effects of atropine are too well known to need any detailed exposition in this paper. Suffice it to say that in our experiments the instillation of a 1 per cent solution of atropine sulfate produced complete mydriasis and the disappearance of the pupillary reflex to light and accommodation. The accommodation of the lens disappeared, and the intra-ocular tension increased. However, the synergistic effects of this drug with benzedrine are important enough to reemphasize. The complete abolition of the effects of mecholyl by atropine appears as regularly as theory demands. The abolition by the use of atropine of the effects of prostigmin in combination with mecholyl is neither so striking nor so complete. Apparently the addition of prostigmin modifies the action of atropine to a certain extent. This has appeared to be the case in our work on the heart. The abolition of the esterases by prostigmin, if this is its total effect, seems to permit a longer effect of mecholyl.

It is important to note that atropine does not widen the fissure, and in this respect is not synergistic with benzedrine. This illustrates one of the principles of autonomic pharmacology, namely, that atropine has no direct sympathetic stimulation but produces its effects by checking or inhibiting the action of acetylcholine. If a sympathetic influence is present, then, the brake being removed from its activity, an increased sympathetic effect is noted. On the other hand, as in the case of Müller's muscle, as there is no brake to remove, since there is no stimulation of acetylcholine normally present, the activity of Müller's muscle is not changed, and the fissure remains unaltered.

COMMENT

In the first place, the eye is the only organ in which experiments with the drugs used by us can be made without the creation of general effects. Apparently the drugs are absorbed and destroyed by the local tissues and structures without any noticeable absorption into the general circulation. Moreover the eye is capable of withstanding a dose of combined mecholyl and prostigmin which would be fatal if injected under the skin. Thus, by mistake, 2 drops of the 10 per cent solution of prostigmin plus 2 drops of the 10 per cent solution of mecholyl were given intradermally to a patient. Within fifteen seconds he was in collapse, and only the prompt administration of atropine and epinephrine corrected the error. Yet the eye suffers no ill effects from a dose which overwhelms the entire body.

Moreover, when mecholyl is introduced into the general circulation the eye partakes in much lesser measure and after a longer interval than do the other organs. A dose of mecholyl sufficient to lower the blood pressure 40 to 60 mm. of mercury, to change the gastric secretion from +20 to —50 HCl, to bathe the whole upper part of the body in a profuse alkaline sweat and to shift remarkably the tonus of the smooth muscles of the rest of the body has almost no discernible effect on the eye. The same is true of benzedrine and epinephrine. The general effects of these drugs, when subcutaneously administered, are enormously spread throughout the organism, but the eye does not partake of the disturbance in anything like proportionate measure. Atropine, although it affects the eye, produces its general effects much earlier than its ocular changes. Since prostigmin is largely silent in its effects, except on the atonic intestine, little can be said concerning the relationship of the general and the ocular effects of this drug.

Concerning the pupillary size, the facts we adduce are in line with the general knowledge. So far as we know, benzedrine has never been used as a mydriatic, nor has prostigmin been used as a miotic. The synergism between benzedrine and atropine seems clinically useful, since it is possible to produce complete cycloplegia of short duration, with little increase in the intra-ocular tension. The method of iontophoresis in respect to mecholyl seems useful in bringing about gentle effects in the eye, as elsewhere in the body.

The intra-ocular tension is, in certain respects, a resultant of the balance between cholinergic stimulation, choline esterase and adrenergic stimulation and closely corresponds to such functions as the heart rate and the secretions of the stomach. The pressure lessens with cholinergic stimulation (after the instillation of mecholyl) or with the inhibition of the esterases (after the instillation of prostigmin). It increases when the cholinergic substances are shut off from action (after the instillation

of atropine sulfate). It increases when there is adrenergic stimulation (after the instillation of benzedrine sulfate). Whatever the hidden modus operandi of this relationship to the autonomic pharmacology may be, the fact that the effect of these drugs on the intra-ocular tension stands in a classic and expected relationship seems to us to be certain. (See Imachi.[18])

The reaction of the accommodation of the lens does not correspond to expectation. Anatomically, the lens is a unilateral mechanism entirely innervated by the parasympathetic fibers from the midbrain, yet benzedrine has an effect on accommodation of the lens. However, an explanation can be found for this effect, namely, the fact that benzedrine acts directly on the ciliary muscle to relax this muscle; that is to say, it does not necessarily follow that the effect of the instillation of substances into the eye actually proves anything about their normal nervous relationships. Thus, the ciliary muscle may be capable of responding to a sympathomimetic drug brought directly into relationship with it, as by instillation, and yet have no normal sympathetic action. While it would be expected that mecholyl, by positive stimulation of the fibers of the ciliary muscle, would bring about an increased curvature of the anterior surface of the lens, thus heightening the power of accommodation, the effect of prostigmin, while expected in certain measure, exceeds expectation in quantitative relationship. In other words, the esterases seem to play an exceptional rôle in the contraction of the ciliary muscle. One might assume that while acetylcholine is being produced in the presbyopic eye, the amount of esterases present prevents accommodation, and that prostigmin, by removing the inhibitor, allows the acetylcholine normally produced to act with vigor on the ciliary muscle and thus on accommodation.

SUMMARY

1. Mecholyl (acetylbetamethylcholine hydrochloride), in a 1 to 10 per cent solution, when instilled into the conjunctival sac constricts the pupil to miosis but permits the reaction of the pupil to light until extreme miosis has been reached. It increases the accommodation of the lens and decreases the intra-ocular tension. It narrows the palpebral fissure and probably dilates the blood vessels of the retina.

2. Prostigmin, in the eye, as elsewhere in the body, is a synergist of the effects of mecholyl, besides having the same general effects when used by itself. It has an especially noteworthy effect on accommodation, increasing the power of the lens to accommodate to the near point.

18. Imachi, K.: Experimental Investigation of Ocular Pressure and Its Relation to the Tone of the Vegetative System, Acta soc. ophth. jap. **36**:79 (July) 1932.

3. In the eye, as elsewhere in the body, atropine sulfate prevents the action of mecholyl and abolishes its reactions when these are present. Therefore it dilates the pupil and paralyzes the constrictor muscle of the iris, thus bringing about an absence of reaction to light. It increases the intra-ocular tension, since the parasympathetic nervous system seems to lower this tension. In addition it paralyzes the accommodation of the lens to the near point, since the ciliary muscle, which brings this about, is cholinergic in function. It does not widen the palpebral fissure.

4. Benzedrine sulfate acts adrenergically in all respects on the eye. It dilates the pupil and diminishes the light reflex, although it does not abolish the reaction to sharp daylight. It increases the intra-ocular tension and diminishes the capacity of the lens to accommodate to the

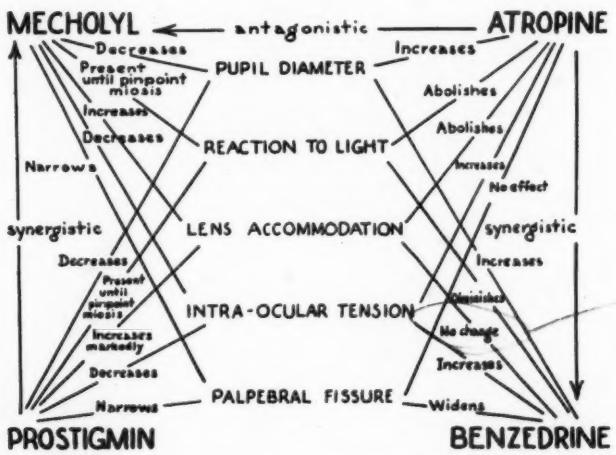

Fig. 3.—Chart showing the effects of mecholyl, prostigmin, atropine and benzedrine on the functions of the eye.

near point. It widens the palpebral fissure strikingly but does not produce exophthalmos. It narrows the arteries and veins of the retina. It reacts synergistically with atropine sulfate. A subminimal dose of benzedrine sulfate combined with a subminimal dose of atropine sulfate will bring about marked miosis and cycloplegia, with little change in the intra-ocular tension.

Merck & Co., Inc., furnished the mecholyl used in these experiments; Smith, Kline & French supplied the benzedrine sulfate, and Hoffmann-La Roche, Inc., the prostigmin.

Dr. Benjamin Sachs checked and controlled the studies by his own observations, especially in respect to the accommodation of the lens under the influence of prostigmin, the question of exophthalmos and enophthalmos, and the intra-ocular pressure.

TUMOR OF THE OPTIC CHIASM AND OPTIC NERVES

REPORT OF A CASE

JESSE M. LEVITT, M.D.
BROOKLYN

Primary tumor of the optic nerve in general is rare. That arising at the intracranial portion of the optic nerve and the optic chiasm is particularly so. This usually occurs in childhood and sometimes is associated with generalized neurofibromatosis, or Recklinghausen's disease. The most significant and often the only signs are ocular. Primary atrophy of the optic nerve associated with divergent strabismus in one eye is a common finding. Occasionally there is a superimposed papilledema. Studies of the visual fields show either total blindness in one eye and hemianopia in the other, or bitemporal or homonymous hemianopia. The roentgen rays are helpful in diagnosis. The sella turcica is often deformed and the optic foramen enlarged. The growth of the tumor is slow; invasion of the orbit producing exophthalmos occurs late. Surgical intervention is not indicated. The diagnosis is often difficult, and surgical intervention is undertaken as an exploratory measure. The usual lesions which give rise to difficulty in diagnosis are meningioma and craniopharyngioma, both amenable to surgical intervention. Roentgen treatment is beneficial.

Lundberg [1] recently wrote an excellent monograph dealing with the clinical and pathologic aspects of primary tumor of the optic nerve and chiasm. The ocular diagnosis in many cases which later were proved to be instances of tumor of the nerve and chiasm was retrobulbar neuritis. The point is stressed that many cases of unexplained blindness or atrophy of the optic nerve may belong to this category, particularly in the early stage, in which field defects and other signs are lacking. The early age incidence, the loss of vision preceding exophthalmos and the relatively small degree of limitation of ocular motility are presented as important points in distinguishing intrinsic tumor of the optic nerve from meningioma.

Read before the Brooklyn Ophthalmological Society, April 15, 1937.

1. Lundberg, A.: Ueber die primären Tumoren des Sehnerven und der Sehnervenkreuzung, Inaug. Dissert., Stockholm, Nordiska Bokhandeln, 1935.

REPORT OF CASE

History.—Mrs. E. H., 43 years of age, was examined by me at the ophthalmologic outpatient department of the Jewish Hospital of Brooklyn in January 1936 and hospitalized in May. She complained that the vision of the left eye had gradually failed over the course of ten to fifteen years, reaching a state of total blindness five months prior to the first examination. The same eye had become more prominent within the past three months. Drooping of the left upper lid of recent onset was also observed by the patient. There were no general symptoms. The past and the family history were not significant.

Ocular Examination.—Vision of the right eye was 20/50 and with correction was 20/20; vision of the left eye was nil.

There was ptosis of the left eye, the lid covering the upper half of the cornea. The globe was slightly divergent and definitely proptosed. Rotation nasally and downward was markedly limited. The pupil was slightly dilated and did not react to direct light but reacted consensually. There was no pulsation of the globe or bruit. Palpation of the orbit gave negative results. Corneal sensation was unimpaired. The media appeared entirely clear. The optic disk was completely white and clearly outlined; the retinal blood vessels were normal.

The right eye was normal in every respect except that examination of the visual field revealed temporal hemiachromatopsia for red and green.

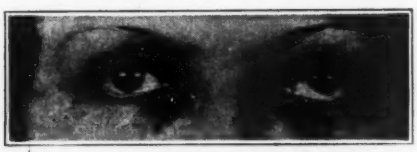

Fig. 1.—Photograph showing ptosis and exophthalmos of the left eye.

With the Hertel exophthalmometer the reading for the right eye was 13 mm. and that for the left eye 21 mm.

General Study.—Physical examination revealed a fairly well nourished white woman. The findings were limited to the eye. The blood pressure was within normal limits. All the reflexes were normal. No facial weakness and no sensory or motor disturbances were present. No neurofibromatosis was found. Examination of the nose, throat and sinuses, including roentgen study, did not disclose any significant pathologic changes.

Roentgen studies of the skull (figs. 2 and 3) showed a normal cranial vault, a shallow sella turcica, erosion of the anterior and posterior clinoid processes and erosion of the left sphenoid ridge. The left optic foramen appeared to be enlarged to twice the size of the right.

The Wassermann and Kahn tests of the blood gave negative reactions; the blood chemistry and the hematologic picture were normal, and urinalysis yielded negative results.

Course.—Craniotomy was performed, and a massive chiasmal growth was exposed. No attempt at removal was made. The patient died on the twelfth postoperative day.

Postmortem Examination.—This showed an unusual picture. The left optic nerve was about the size of a lead pencil, discolored, cystic and neoplastic in appearance. The optic chiasm was replaced by a mass of neoplastic tissue arising

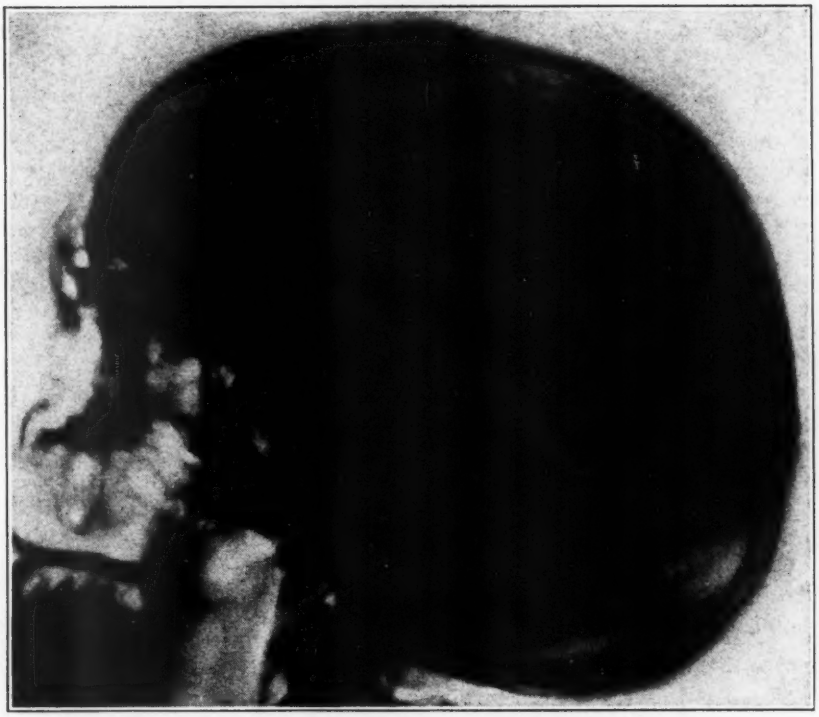

Fig. 2.—Lateral roentgenogram of the skull, showing the shallow sella turcica and erosion of the anterior and posterior clinoid processes.

Fig. 3.—Anteroposterior roentgenogram of the skull, showing erosion of the left sphenoid ridge.

apparently in situ. The tissue was brown and yellow, with small cystic areas. The neoplastic optic nerve at the point where it passed the optic foramen had eroded the surrounding bone, resulting in a friable and crumbling sphenoid ridge. As the optic nerve passed into the orbit it mushroomed out into a red, fleshy growth which occupied the retrobulbar space. The anterior and posterior clinoid processes were eroded. The right optic nerve was swollen to about twice the normal size and at its proximal portion was infiltrated with neoplastic tissue spreading from the chiasm. There appeared to be a thinning of the left ventricle due to pressure upward of the chiasmal mass.

Microscopic examination of the tumor disclosed a glioma of a very vascular nature.

SUMMARY

A case is reported of a white woman of 43 years with a history of slow loss of vision of the left eye of many years' duration, progressing to complete blindness, and of exophthalmos and ptosis of the same eye, of recent onset. The positive findings were divergent strabismus and primary atrophy of the optic nerve of the left eye. The visual fields of the right eye showed temporal hemiachromatopsia for red and green. There were no general signs. Roentgenograms of the skull revealed a shallow sella turcica, erosion of the anterior and posterior clinoid processes, erosion of the left sphenoid ridge and enlargement of the left optic foramen. Operation disclosed a massive chiasmal tumor. Postmortem examination showed a tumor apparently arising from the chiasm and spreading laterally to involve both optic nerves and on the left side extending into the orbit, with resultant forward displacement of the globe.

734 Ocean Avenue.

TREATMENT OF CAROTID ARTERY-CAVERNOUS SINUS FISTULA

REPORT OF A CASE

JEFFERSON BROWDER, M.D.
BROOKLYN

In 1933 Hamby and Gardner [1] reported their observations following several surgical procedures which they employed in an attempt to bring about cure in two cases of fistula between the carotid artery and the cavernous sinus. In their case of significance in the present discussion (case 2) the patient had, in the order given, ipsilateral ligation of the extracranial portion of the internal carotid artery and the common carotid artery, ligation of the intracranial portion of the internal carotid artery distal to the lesion and finally ligation of the extracranial portion of the internal carotid artery and the common artery contralateral to the fistula. Two years later Dandy [2] reported the results following ligation (clipping) of the intracranial portion of the internal carotid artery in two patients who had a traumatic fistula between the cavernous sinus and the internal carotid artery. In each of these two instances there had been ligation of the extracranial portion of the internal carotid artery prior to the "clipping" of the intracranial portion of this artery. The reported results in these three cases indicate that ligation of the intracranial portion of the internal carotid artery (distal ligation of Brasdor) is applicable in those instances in which the intradural portion of the artery is not implicated in the pathologic process.

The following report illustrates the inadvisability of ligating the intracranial portion of the internal carotid artery in certain cases and describes an alternative for occluding a carotid artery-cavernous sinus fistula.

REPORT OF CASE

A 33 year old man was admitted to the hospital complaining of headache, vomiting and failing vision. When 7 years of age he was said to have fallen from a moving wagon and to have struck the occipital region of his head, which produced immediate unconsciousness. There was bleeding from the nose and ears, and the

Read before the Brooklyn Ophthalmological Society, Feb. 8, 1937.

1. Hamby, Wallace B., and Gardner, W. James: Treatment of Pulsating Exophthalmos, with Report of Two Cases, Arch. Surg. **27**:676 (Oct.) 1933.

2. Dandy, Walter E.: Treatment of Carotid Cavernous Arteriovenous Aneurysm, Ann. Surg. **102**:916, 1935.

right eyelids were markedly swollen. After the return of consciousness, at the end of four days, it was noted that the left side of the face was paralyzed. He slowly recovered from this facial paralysis, but not completely so, a "difference" remaining between the two sides of the face. The swelling of the right eyelids subsided, but the eyeball on this side remained more prominent than its fellow. This protrusion of the right ocular bulb was noted to be more striking whenever he was excited or angry. He attended school until 16 years of age but was unable to finish the grammar grades. At 15 his vision was found to be defective, and since this time he had worn glasses. He had never been steadily employed, but worked at odd jobs as a handy man. As long as he could remember there had been a roaring noise in the head, sometimes loud enough to disturb his sleep. Difficulty in hearing had been present since the accident.

Although there had been occasional headaches all his life, in October 1935 he began to experience severe shooting pains across the frontal region of his head, which were more marked on the right side than on the left. These attacks of pain in the frontal region increased in frequency and on several occasions were associated with nausea and vomiting. Although his vision became progressively less acute during this time, the right eye did not become more prominent, and there was no appreciable change in either the character or the intensity of the noise in the head. No bleeding from the nose was reported. The pain in the head, vomiting and failing vision slowly became more marked, and he entered the hospital on Jan. 6, 1936.

Physical examination disclosed a sparsely built and poorly nourished man with an obvious defect of hearing. The right ocular bulb was prominent and displaced downward and outward (fig. 1). The lids of the eye, the right malar region and the right side of the forehead had a bluish tint due to the large and thickly set subcutaneous veins. The bulbar conjunctiva of the right eye was mildly chemotic, and the vessels of its mesial half were prominent. There was a visible as well as a palpable forward thrust of the affected eye at each cardiac systole. On palpation the large blood vessels that coursed vertically across the right side of the forehead were noted to have walls of such thickness that one gained the impression that the frontal bone was grooved. Obliteration of the flow of blood in these vessels by external pressure, first at the eyebrow and then at the hair line, indicated that the blood flowed from the orbital zone upward. A thrill with systolic intensification could be felt at any point about the right orbital area but was most striking at the inner aspect of the right upper lid. A soft, easily compressed prominence extended across the base of the nose. This seemed to be a large blood vessel communicating with the vessels of the medial aspect of the left orbital area. On auscultation over any part of the head a loud continuous bruit with a systolic accentuation could be heard. It was impossible to choose between the area about the base of the nose and the right temple as the point where this murmur was heard with maximum intensity. No musical quality could be detected, even after moderate exercise. Attempts to press the right globe into a normal position caused pain, although no great resistance was offered by the intra-orbital structures. The pupils were equal and reacted promptly to light and in accomodation. The optic nerve heads were sharply outlined and showed a mild degree of pallor. The veins of the right optic fundus were mildly engorged as compared with those of the left fundus. The visual fields showed marked concentric constriction. No scotomas could be demonstrated. The extra-ocular movements were not impaired, except for upward gaze, which was limited on the right side to the horizontal level. Strong attempts to gaze upward caused the right ocular

bulb to rotate inward. The fifth cranial nerves were intact. Very slight paresis of the left facial muscles could be demonstrated. Hearing was impaired, and this defect was shown by tests to be a lesion affecting conduction bilaterally. The remainder of the cranial nerves were considered normal. The neck was thin, and the pulsations of the right common carotid artery were more marked than those of the left. On palpation the right common carotid artery seemed to be about twice the size of the artery on the left side. Digital compression of this artery produced no change in the cranial bruit. The radial pulse rates were equal, and the blood pressure was equal in the two arms, the systolic pressure being 104 mm. of mercury and the diastolic pressure 48 mm. The heart was found to be small on physical and roentgen examination. The deep and superficial reflexes were present and were equal on the two sides. No sensory changes could be demonstrated.

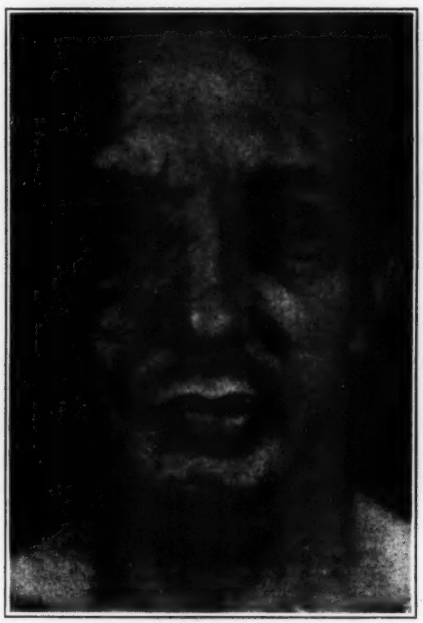

Fig. 1.—Photograph of the patient taken on his admission to the hospital, showing the prominently displaced right optic bulb.

The gait and the equilibrium were within normal limits. Except for mild secondary anemia, all the laboratory examinations showed normal findings. The exophthalmometer readings were: 113 mm. at the base line, 27 mm. for the right eye and 12 mm. for the left eye.

On Jan. 13, 1936, with the patient under anesthesia induced with tribromethanol in amylene hydrate, 125 cc. of clear cerebrospinal fluid was removed fractionally by lumbar puncture and an equal quantity of air introduced. Roentgenograms of the head taken immediately after the introduction of the air showed a normally placed cerebral ventricular system. The entire system was moderately dilated, with the exception of the fourth ventricle, which was considered to be within normal limits. The right lateral ventricle showed a greater degree of dilatation than the corresponding ventricle of the left cerebral hemisphere (fig. 2).

On January 18, with the area under local anesthesia, the right common carotid artery and its two branches (the internal and the external carotid artery) were widely exposed and isolated. The lumen of the common carotid artery was completely occluded by a broad tape placed externally, and this occlusion was maintained for ten minutes. No abnormal signs or symptoms were observed during this period. Neither the size nor the tension (as noted on palpation) of the internal carotid artery was altered during this procedure, nor was the bruit in the head altered. Without removal of the occluding tape from the common carotid artery, a similar tape was placed around the right internal carotid artery, and its lumen was completely occluded. The patient was carefully observed (in regard to the fundi, the pulse rate, the blood pressure, respiration and the motor and sensory functions of the left extremities) for fifteen minutes; at the end of this period no change had been noted except a 40 to 50 per cent reduction in the intensity of the bruit as heard in the temporal fossae. Thereupon the internal carotid artery was doubly ligated with a silk suture, and the compressing tape was removed

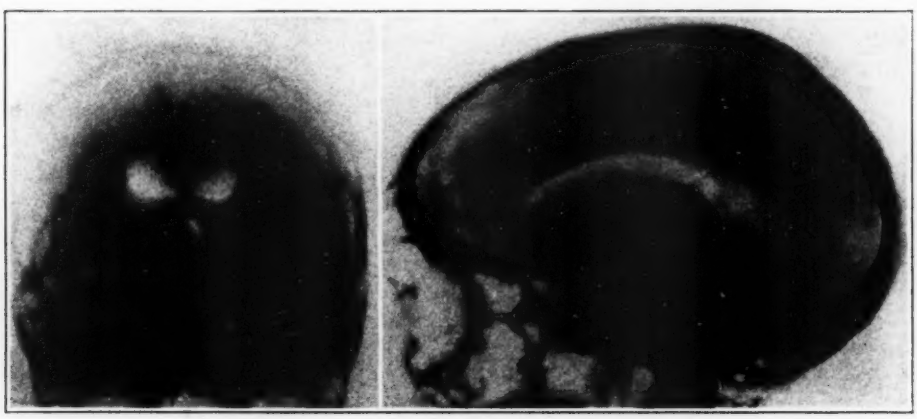

Fig. 2.—Anteroposterior and lateral views of the skull taken after the introduction of air by the lumbar route. In the anteroposterior view the general ventricular dilatation can be seen; the right lateral cerebral ventricle is larger than the left.

from the common carotid artery. Hemostasis was completed, and the wound was closed with a silk suture.

There were no untoward signs or symptoms following this operation. Two days after operation the right eye was less prominent but was still moderately proptosed and displaced (fig. 3). The intracranial bruit was considerably reduced in intensity but was easily heard with a stethoscope over all parts of the head. The thrill, which was palpable at about the inner aspect of the right orbit, was present. The patient was allowed out of bed on the fourth postoperative day. Although there was some improvement, in that the right ocular bulb had receded slightly and the intracranial murmur had become less intense, the visual fields showed little change. It was roughly estimated by these signs that the blood flowing through the arteriovenous fistula had not been reduced more than 25 to 30 per cent. After a five week period of observation, the intracranial bruit, as compared with that present immediately after the ligation of the internal carotid artery, had become more intense. At this time the exophthalmometer readings were: 113 mm. at the base line, 27 mm. for the right eye and 14 mm. for the left eye. Since the

ligation of the extracranial portion of the internal carotid artery had not resulted in satisfactory amelioration of the symptoms and signs, it was decided to ligate the intracranial portion of this artery, as advocated by Hamby and Gardner.

On March 3, with the patient under anesthesia induced with tribromethanol in amylene hydrate and the part under local anesthesia, the infundibulochiasmal area was exposed through a flap in the right frontal bone. An unexpected and unusual condition was observed. A vein fully 5 to 6 mm. in diameter ran parallel to the right lateral aspect of the optic chiasm and extended from the right optic foramen to a point level with the communication of the great petrosal vein with the cavernous sinus. There it crossed the right optic tract and entered the dural covering of what seemed to be the posterior aspect of the cavernous sinus. A second abnormal vein about 3 mm. in diameter coursed from the right optic

Fig. 3.—Appearance of the patient two days after ligation of the cervical portion of the right internal carotid artery.

foramen across the anterior aspect of the optic chiasm and entered the left optic foramen just medial and superior to the left optic nerve (fig. 4). Both these veins showed pulsations which were synchronous with those of the arteries exposed in the operative field. The arachnoid was moderately thickened about the entire chiasmal area. This was removed from the right side, and the right optic nerve, chiasm and optic tract, with the accompanying vein, were retracted mesially. In the usual position for the intracranial portion of the internal carotid artery there was an elongated, slightly domed pulsating surface, partial collapse of which could be produced by lateral compression over the cavernous sinus. From the distal part of this structure the internal carotid artery emerged and divided immediately. There was not space enough between the point of emergence of the internal carotid artery and its bifurcation (into the anterior and the middle cerebral artery) to permit application of a compression clip without partially or completely occluding

Fig. 4.—An artist's elaboration of the operator's sketch, showing the enlarged anomalous veins about the chiasm, as described in the text.

Fig. 5.—Appearance of the patient twenty days after the intracranial operation.

either or both of these branches (the right posterior communicating artery was not visualized). The hope of reducing the blood supply to the arteriovenous fistula by ligating the intracranial portion of the internal carotid artery was of necessity abandoned. It was discovered that on lateral compression of the area of the right cavernous sinus there was almost complete collapse of the two pulsating veins previously described. It was assumed that such compression mechanically blocked the fistula and that the collapsible mass occupying the position of the intracranial part of the carotid artery could be opened without causing excessive hemorrhage. A piece of temporal muscle approximately 1.5 cm. square and of the thickness of this muscle was cut, and when every detail was made ready the dome of the presenting mass was opened. The muscle was immediately introduced into the cavity, which it filled almost completely. The lateral compression was slowly released, and moderate pressure was applied over the small incision opening. After a period of waiting for maximum coagulation, the borders of the incision opening were fused with the enclosed muscle plug by the electrocoagulation unit. It was observed that the abnormal pulsating veins shown in figure 4 remained partially collapsed. After hemostasis of the wound, the bone flap was wired and the scalp closed with layer silk. Auscultation of the head while the patient was still on the operating table failed to disclose a murmur. The right pupil was widely dilated at this time, whereas the left was in middilatation.

The patient recovered satisfactorily from this procedure, and at no time during the postoperative course did he show evidence of any disturbance in the left extremities. The dilated right pupil returned to the size of its fellow in three days. There was marked improvement in vision. The condition of the eyes is shown in figure 5; this photograph was taken twenty days after the second operation. The prominence of the right eye became progressively less over a six month period, since which time it has remained about the same. The cranial bruit is not audible over any part of the head. The result at the end of one year seems entirely satisfactory.

COMMENT

As was stated in this patient's history, the traumatic carotid artery-cavernous sinus fistula on the right side was sustained when he was 7 years of age, and, as far as could be determined, the symptoms, aside from the evident intellectual deficiency, remained stationary for some twenty-five years. The fact that he had the lesion throughout most of the period of his physical development may account in part for the unusual anatomic findings at the time of the intracranial operation. No adequate textbook account of the veins within and about the optic chiasm could be found that gave a description of vessels which occupy the positions of the enormously enlarged veins here illustrated. Neither have I been able to find in the fresh cadaver veins, however, minute, so placed anatomically that they might dilate in the presence of a long-standing carotid artery-cavernous sinus fistula. It seems logical to assume that direct pressure of these large veins on the optic nerve within the optic foramen is the explanation of the visual disturbance in this case.

The slight general cerebral ventricular dilatation shown by the encephalogram may not be explicable on the basis of disturbance of

the blood supply to the brain; however, the fact that the right lateral ventricle was larger than the left lateral ventricle strongly supports the idea that the right cerebral hemisphere, as might be expected, had been deprived of a normal blood supply. The inability of this patient to advance in school with persons of his age group might also be attributed to the disturbed cerebral vascular condition.

Although direct occlusion of an arteriovenous fistula, such as was carried out in the instance herein reported, is the operation of choice, the technical safety of such a procedure is open to question. The occlusion of vascular channels by electrocoagulation is not as dependable as that accomplished by mechanical ligatures; yet this method is becoming more and more popular as a hemostatic agent in intracranial surgical procedures.

It would seem that a patient with a carotid artery-cavernous sinus fistula which is producing disturbing symptoms should be treated as follows:

1. Repeated digital compression of the affected internal carotid artery in the neck, if such compression produces cerebral symptoms and signs, may be helpful.

2. Mechanical occlusion of the common carotid and the internal carotid artery on the involved side, after they have been exposed, with the area under local anesthesia, may be carried out.

3. If these methods fail, ligation of the intracranial portion of the internal carotid artery just distal to the cavernous sinus should be performed.

4. If the intracranial portion of the affected internal carotid artery should prove to be implicated in the aneurysmal formation, the aneurysmal cavity may be opened and the fistula occluded with a piece of muscle.

Clinical Notes

A CASE OF OPACITIES OF THE VITREOUS OBSERVED FOR TWENTY YEARS AFTER SCLERO-CORNEAL TREPHINING

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On Nov. 2, 1916, the vision of the left eye of a 28 year old farmer was reduced to perception of light by a hemorrhage into the vitreous. On November 4 a complete survey, including a serologic study of the spinal fluid, gave negative results, but the teeth and tonsils were finally removed as suspicious. The vision of the left eye was limited strictly to perception of light for six months, after which time perception of light was lost permanently because of organization of the hemorrhage, and there was total detachment of the retina.

On March 4, 1917, a massive intravitreous hemorrhage in the "normal" right eye reduced the vision in this eye from 20/20 to perception of light. On June 18 a complete survey, including tests for sensitivity to tuberculin, carried out at the Mayo Clinic, gave negative results.

On August 7 the patient was seen by Dr. George E. Henton for the first time. The patient had been totally blind for six months, except for perception of light with the right eye, and he was much depressed. The vitreous of each eye was filled with débris, so no details of the fundus were visible.

For some time Dr. Henton had felt that a properly performed sclerocorneal trephining might facilitate elimination of vitreous opacities in carefully selected cases. It seemed advisable to apply this somewhat experimental procedure in this particular case, since the course in the right eye was apparently following that in the totally blind left eye, with no known treatment available. This was thoroughly explained to the patient and his family, and they unanimously requested that the operation be performed. With this understanding Dr. Henton performed a sclerocorneal trephining operation on the right eye on September 2. The vitreous slowly cleared after this operation, and after March 1918 the vision of the right eye was always 20/30 plus, without glasses.

As the fundus became visible for the first time since the hemorrhage on March 4, 1917, the upper temporal artery was seen to be occluded at a point 2 disk diameters from the center of the disk. There was an area of fibrosis and pigmentation about twice the size of the disk at this point in the fundus, and from this point a membrane of fibrous tissue extended into the vitreous. It was evident that the hemorrhage into the vitreous had originated from the point of occlusion of the upper temporal artery of the right eye. There was marked beading of the retinal arteries, with arteriovenous notching.

On Feb. 19, 1937, Dr. F. A. Kiehle confirmed our findings with the following report:

I have today examined Mr. A. W. and find that his vision is as follows: in the right eye, 20/30 plus, and in the left eye, no perception of light. The right eye shows a sclerocorneal trephine wound with a small bleb in the 12 o'clock position. The media are clear; the pupillary reaction is normal; the vitreous shows a wide, distinct gray band attaching from the disk along the route of the upper temporal artery superiorly and to the lower nasal region inferiorly—evidently the result of an old hemorrhage. It is impossible to get a clear view of the interior structure of the left eye, probably on account of an old intraocular hemorrhage.

At this time general physical examination gave negative results, except that the basal metabolic rate was lowered, on the probable basis of cerebral arteriosclerosis.

Dr. William L. Benedict and Dr. Frederick A. Kiehle supplied data published in this case report.

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METASTATIC PANOPHTHALMITIS FROM PYOGENIC CUTANEOUS INFECTIONS

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Metastatic panophthalmitis occurs fairly frequently, and cases of this condition in association with pneumonia, tonsillitis, meningitis, cholecystitis, parotitis and other diseases have been reported. In 1930 I [1] reported in the ARCHIVES a case of metastatic panophthalmitis occurring in association with calculous pyonephrosis. In this case Bacillus coli was the offending organism. Recently I had the opportunity of writing the pathologic report on an eye enucleated for metastatic uveoscleritis in a case of pneumonia. This case was reported in the ARCHIVES by Dr. Hulka.[2] In both these papers a complete bibliography was given and need not be repeated here. During the past few months my associates and I have had occasion to see at the Mount Sinai Hospital two cases of this condition occurring in association with meningococcic meningitis. It is of interest to note that in all the cases of subacute bacterial endocarditis which we have observed in the medical wards there has been no occurrence of metastatic panophthalmitis. Apparently Streptococcus viridans, which is responsible for many embolic phenomena in various organs, including the eyes, does not

1. Levine, Joseph: Metastatic Bacillus Coli Panophthalmitis from Calculous Pyonephrosis, Arch. Ophth. **3**:410 (April) 1930.

2. Hulka, Jaroslav H.: Metastatic Pneumococcic Uveoscleritis Following Pneumonia, Arch. Ophth. **17**:127 (Jan.) 1937.

initiate a suppurative process but rather causes a hemorrhagic reaction. It is also possible that the emboli are aseptic.

In a thorough search of the literature I have not been able to find an instance of metastatic panophthalmitis following a pyogenic infection of the skin.

The first case of this condition which I shall report is that of an Italian man 48 years old, who was admitted to the surgical service of the Mount Sinai Hospital in October 1935 for treatment of a large carbuncle of the neck. The patient was known to have diabetes and had been receiving 30 units of insulin daily. On admission his blood sugar content was 225 mg. per hundred cubic centimeters, and his urine contained 2 per cent of sugar. The amount of insulin that he received was increased to 45 units daily, and the carbuncle was incised and drained. Healing was slow, and three days after the operation his left eye became red and painful and he complained of blurred vision. Examination showed marked circumcorneal injection, a cloudy aqueous, a small pupil and edema of the lids. He was able to count fingers at 5 feet (1.5 meters). Despite local treatment with atropine and hot applications a hypopyon developed the following day. The blood sugar content at this time was 150 mg. per hundred cubic centimeters, and the urine contained 0.5 per cent of sugar. The vision of the eye two days later was limited to bare perception of light, and the local signs had progressed. Pain was extremely severe, and evisceration was performed. A culture taken at the time of operation yielded Staphylococcus aureus, which was the organism obtained from culture of the carbuncle at the time of incision.

The second case is that of a white man 60 years old who had had no history of ocular disturbance. His previous history was irrelevant. Two weeks prior to his admission to the hospital a rather large furuncle developed near the left nostril, with subsequent redness and swelling of the left side of the face. This swelling subsided in a week, but the furuncle was not entirely healed. The following day he noticed some impairment of vision of the right eye; the lids became edematous, and there was pain. Within two days the vision was reduced to perception of light, the eye bulged, pain was excruciating, and the edema increased. The family physician diagnosed the condition as acute glaucoma and referred the patient to the Mount Sinai Hospital. On his admission we found a healing furuncle of the left nostril. The right bulbar conjunctiva was chemotic and edematous; the eye could not be rotated and was proptosed directly forward; the lids were red and swollen; the pupil was extremely small, and the iris was bound down by exudate; the aqueous was cloudy, and the fundus could not be seen. The vision was sufficient to permit perception of movements of the hand. The patient's general condition, together with the local ocular signs and the history of loss of vision prior to the onset of proptosis and swelling, ruled out thrombosis of the cavernous sinus and orbital abscess. A culture of the blood gave negative results, but a culture taken from the eye at the time of evisceration of the globe revealed Staphylococcus aureus. Subsequent to the operation healing was uneventful and the patient was entirely comfortable.

The purulent emboli which come from the original seat of inflammation get into the general circulation, after which they enter the eye either through the central retinal artery, which is a branch of the ophthalmic artery, or through the short and long ciliary arteries, which are also branches of the ophthalmic artery. Regardless of which route (retinal or choroidal) is used, the outcome is the same. A deep-seated

intra-ocular purulent inflammation arises, which necessitates evisceration of the eyeball. It is usually advised not to enucleate such an eye, because in enucleation the optic nerve and its sheaths must be cut, and it is feared that some of the purulent contents of the globe may have spilled onto the conjunctiva and thus be carried back with the enucleation scissors into the optic nerve sheaths, to pass from there into the cranial cavity and cause purulent meningitis. However, such a condition can occur only if there has been perforation of the globe, corneal or scleral, or both, with resultant spilling of the purulent contents. Otherwise, infection is not to be feared, and enucleation is as safe as evisceration.

Ophthalmologic Review

EDITED BY DR. FRANCIS HEED ADLER

PATHOGENESIS OF UNILATERAL EXOPHTHALMOS

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Unilateral exophthalmos is not of necessity similar etiologically to the bilateral condition. There is no doubt that many unilateral exophthalmic conditions may be simply incomplete, in terms of bilateral involvement seen in cases of exophthalmic goiter. It is just as true, however, that in many cases the primary characteristic is unilateral displacement of the eyeball. Involvement of the opposite side would be in such cases secondary and not consequent. Perhaps the best example of such instances is a case of neurofibromatosis.

It seems as though unilateral exophthalmos is properly considered a definite clinical entity in a large number of instances. Even in cases of unilateral exophthalmos associated with exophthalmic goiter this condition, in my experience, presents various signs less commonly seen in cases of the bilateral variety. There is no certain reason why exophthalmos should at times be almost purely unilateral, but the fact stands that cases of this condition do occur, and the disorder need not become bilateral at some later stage. Differences in the degree of exophthalmos in both eyes, when this is gross, may account for some cases of unilateral exophthalmos, especially those in which equal exophthalmos develops later in the progress of the toxic state.

The anatomic reasons for exophthalmos are not complex.

Wolff,[1] in his description of the orbit, spoke of it as a goblet-shaped cone open in front, within which, posterior to the eyeball, there is a closed fasciomuscular space. Eagleton[2] said: "Overfilling of this space, even from slight circulatory disturbances, which in other parts of the

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This review is a further consideration of unilateral exophthalmos, based on a paper, "The Etiology of Unilateral Exophthalmos," read before the Pennsylvania State Medical Society on Oct. 6, 1936, and a paper, "The Pathogenesis of Unilateral Exophthalmos: Inflammatory and Traumatic Causes," read before the Section on Ophthalmology of the College of Physicians of Philadelphia on Oct. 22, 1936.

1. Wolff, E.: The Anatomy of the Eye and Orbit, London, H. K. Lewis & Co., Ltd., 1933, p. 310.

2. Eagleton, W. P.: Exophthalmos from Surgical Diseases, Especially as to Involvement of the Protective Retrobulbar Space, Arch. Ophth. **14**:1 (July) 1935.

body gives rise to flushing and congestion, as in hyperthyroidism, here causes exophthalmos." The orbit is of mesoblastic origin, filled with elements of ectodermal and mesodermal origin and formed of rigid walls from the same embryonal source; and it contains highly specialized neural tissues from the fetal forebrain. Adult dural elements appear in its apex, and through these a somewhat active connection is present with the intracranial cavity. Further, it is almost wholly without lymphatic tissue, and its veins are without valves. The venous supply is unusually copious, considering its position, and it is closely connected with the venous drainage of the face and of the nasal cavity and with the nasal accessory sinuses emptying into the cavernous sinus and into the pterygoid plexus of veins. The architecture of its bony structure, while favorable to the integrity of the eyeball and its important adnexa, is by reason of its own rigidity a dangerous cul-de-sac for a malignant process and acute infection and for some chronic inflammatory processes. A pathologic condition of the orbit is seldom a cleancut medical or surgical condition from a diagnostic standpoint. More often it is a problem the solution of which taxes every bit of one's diagnostic acumen.

The cases of unilateral exophthalmos can be divided into several different groups from the standpoint of etiology. Such a grouping would include cases of unilateral exophthalmos due to: anatomic conditions—including extra-orbital pathologic disorders—some with no apparent orbital pathologic changes; traumatic conditions; acute, subacute and chronic inflammatory conditions; conditions of the blood-forming and lymphatic systems, and neoplastic diseases. The last group includes nonparasitic cysts as well, even though they are not neoplasms. Space-taking lesions would be, perhaps, a better term for this group. The diseases of the lymph and the hematopoietic system should be considered separately in that, while they have a common anatomic origin, they are not commonly considered in a discussion of the formation of tumor cells.

The following classification is suggested, with the hope that it is a fairly complete one.

Anatomic Conditions.

1. Unilateral myopia of a high degree.
2. Defects in the vault of the orbit; meningocele and meningo-encephalocele.
3. Exophthalmos associated with ocular hypertension.
4. Exophthalmos associated with arterial hypertension.
5. Pseudo-exophthalmos resulting from retraction of the lids.
6. Intermittent exophthalmos.
7. Disease of the pituitary gland.
8. Exophthalmos resulting from irritation of the cervical portion of the sympathetic nervous system.
9. Unilateral exophthalmos associated with toxic goiter.

Traumatic Conditions.

1. Fracture of the orbit (with retrobulbar hemorrhage).
2. Laceration and rupture of the extra-ocular muscles.
3. Traumatic evulsion of the globe.
4. Trauma sustained at birth—intracranial; aneurysm of the internal carotid artery.
5. Foreign body in the orbit.
6. Pulsating exophthalmos; arteriovenous aneurysm.
7. Spontaneous retrobulbar hemorrhage, as from whooping cough.

Inflammatory Conditions.

These must be acute, subacute or chronic.

They are given here roughly in the order of their chronicity.

1. Retrobulbar cellulitis.
2. Retrobulbar phlegmon.
3. Retrobulbar abscess.
4. Thrombophlebitis of the orbital veins.
5. Thrombosis of the cavernous sinus.
6. Erysipelas.
7. Tenonitis (at times suppurative).
8. Periostitis (syphilitic or tuberculous, but not including gumma; pseudotumor; disease of the lacrimal sac).
9. Orbital mucocele; pyocele; cholesteatoma.
10. Orbital exostosis.
11. Paget's disease, with hyperostosis.
12. Actinomycosis; trichinosis; mycotic pseudotumor.
13. Xanthomatosis allied to the Schüller-Christian syndrome.

Diseases of the Blood, the Lymph and the Hematopoietic System.

1. Rickets; scurvy; hemophilia.
2. Lymphosarcoma (Piney; lymphoblastic).
3. Acute and chronic lymphatic leukemia; lympho-endothelioma; Mickulicz' disease (Wolff; malignant lymphoma).
4. Hodgkin's disease (a sclerosing type of lymphoma).
5. Myeloblastoma; chloroma (a bone marrow picture).
6. Myelogenous leukemia (premyelocytes and myelocytes).

Space-Taking Orbital Lesions.

The order here is, roughly, the degree of malignancy, as seen and reported by many different observers.

1. Pseudotumor.
2. Dermoid cyst; sebaceous cyst; gumma.
3. Fibroma.
4. Neurofibroma.
5. Lipoma.
6. Osteoma; osteofibroma.
7. Myxoma.
8. Chondroma and chondromyxoma.
9. Cylindroma of the lacrimal gland.
10. Psammoma.

11. Adamantinoma.
12. Lymphangioma and hemangioma.
13. Plasmoma.
14. Meningioma or endothelioma.
15. Rhabdomyoma.
16. Tumor of glial tissue, such as neuroma, neuroblastoma, retinoblastoma and spongioblastoma polare.
17. Tumor of the sphenoid ridge.
18. Carcinoma.
19. Sarcoma; mixed cell tumor; intra-ocular sarcoma.
20. A malignant growth extending from the nasal accessory sinuses (including carcinoma, sarcoma, psammoma, chondroma and myxoma).
21. A metastatic malignant growth, such as osteogenetic sarcoma, adenocarcinoma and hypernephroma.

ANATOMIC CONDITIONS

Axial myopia, unilateral and of high degree, is not uncommon, and this condition occurs frequently in connection with divergent strabismus as well. The anteroposterior axis of the eyeball attempts to adjust itself to the axis of the orbit. Further, one can see in some of these cases a slight but definite increase in the exophthalmos when the patient rotates his eye toward the contralateral side. The condition in the case which is cited here is representative. The outstanding characteristic was that the parents brought the patient to the ophthalmologist because of the "bulging of the right eye" and not because they were aware of a failure in visual acuity. The patient was the 10 year old son of an army officer. He showed extropia of 15 degrees for both distant vision and near vision, exophthalmos of 9 mm. when looking straight to the front and an increase in this of about 2 mm. when looking toward the left. Central visual acuity was 1/400. There was axial myopia of —18 D., associated with a pathologic condition of the fundus which showed plainly extensive recent progression in the myopia, i. e., macular choroidal sclerosis and a huge peripapillary staphyloma. Examination of the left eye showed a slight degree of hyperopic astigmatism.

Defects in the vault of the orbit may be present and the eye may not show any exophthalmos. Routine roentgen studies of the orbit prove this. These dehiscences are rather commonly connected with the position of the normal sutures. Meningocele, meningo-encephalocele and encephalocystocele have all been reported as causing exophthalmos because of such congenital anatomic defects. Safranek [3] reported a case in which recovery followed surgical treatment. Edson and others have corrected such conditions by operations in which they used a transfrontal approach and implanted bone grafts on the roof of the orbit. A roentgen

3. Safranek, J.: Operierter Fall einer Cephalocele naso-orbitalis, Ztschr. f. Hals-, Nasen- u. Ohrenh. **3**:560, 1922.

examination will be sufficient for the diagnosis in such conditions. In most of the cases the protruding substance enters the orbit through the medial wall.

Figure 1 illustrates a case of meningo-encephalocele observed by Seefelder, of Innsbruck, Austria, and reported by Atkinson. It shows well the presentation through the medial wall, which is common in this condition.

Exophthalmos is occasionally seen, associated with arterial hypertension and with unilateral ocular hypertension, the exophthalmos in both instances being unilateral, without any orbital cause for the proptosis being demonstrable. One patient of Peter's with such a condition was operated on. The operation consisted of approach by a transfrontal route to the anterior fossa, removal of the orbital roof (orbital decompression) and thorough exploration of the orbital contents for the detection of any possible pathologic condition. None was found except

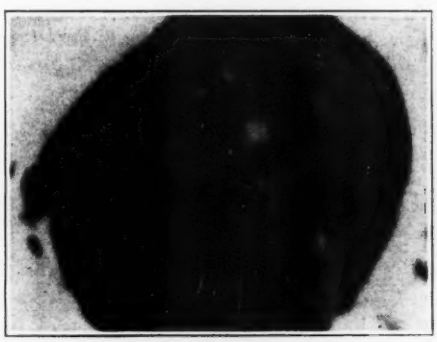

Fig. 1.—Meningo-encephalocele (case of Prof. R. Seefelder, Innsbruck, Austria; from Atkinson, D. T.: External Diseases of the Eye, Philadelphia, Lea & Febiger, 1934; reproduced by permission of the publisher).

a possible increase in the blood supply of the orbital fat. The eyeball continued to show exophthalmos of the same degree and little, if any, difference occurred in the glaucomatous hypertension. Vision has been preserved by other methods. In those cases in which there is arterial hypertension (this was not present in the case just described), the hypertension may be explained on the basis of varicosities of orbital vessels. One patient with such a condition, an inmate of a home for old soldiers, was under observation for several years. He showed unilateral exophthalmos, with thick, moist, painless chemosis of the inferior conjunctival cul-de-sac. Vision was only slightly impaired; this was due, undoubtedly, to the angiosclerotic condition of the retina. The patient was finally sent back to the home of some relatives, the condition having remained unchanged in all the details. The cause of his death is unknown, for nothing further has been heard about him.

Pseudo-exophthalmos is seen not uncommonly in association with various disturbances of cranial nerves. It is not a true exophthalmos. A slight difference may be present in the anteroposterior position of the eyeballs, but this would be familial and not connected with the existing condition. The resemblance to exophthalmos results from widening of the palpebral fissure due to retraction of the lids. At times it seems pronounced. Paralysis of the seventh cranial nerve when present for a long time causes this most frequently. Figure 2 illustrates this condition. The duration of the facial paralysis in this instance was eighteen months; vision was normal, and the patient was distressed only because of the cosmetic deformity.

Intermittent exophthalmos has been described by several observers. Eagleton [2] spoke of a case of this condition in which the exophthalmos was associated with suppurative otitis and recurred with each successive attack. He said:

> As the ocular protrusion could also be produced by pressure over the right jugular vein, or by turning the head to the right, and as it persisted after the aural suppuration had subsided, the intermittent exophthalmos was doubtless due, not to infection, but to a congenital anomaly of the vessels returning the venous flow from the orbit.

Fig. 2.—Pseudo-exophthalmos of the right eye, associated with old facial paralysis.

Posey [4] also reported a case of intermittent exophthalmos, in which the eyeball could be voluntarily proptosed. This case may have been one of a dehiscence of the orbital wall into the ethmoid labyrinth, though varicosities of vessels may equally well have been the cause.

Disease of the pituitary gland is occasionally connected with unilateral exophthalmos, without orbital invasion by a neoplasm. In the two cases of this condition observed by me roentgen examination showed no differences in the two optic foramens, nor were there any oculomotor disturbances to account for the exophthalmos. The condition may have developed from orbital venous stasis, but the veins of the fundus should have shared in this stasis, apparently, and certainly the superficial veins which drain into the cavernous sinus would have shown obstruction.

4. Posey, quoted by Shoemaker, W. T.: Disease of the Orbit, in Ball, J. M.: Modern Ophthalmology, ed. 3, Philadelphia, F. A. Davis Company, 1913.

In spite of the absence of these signs, it is rather probable and logical that venous stasis was the cause for this proptosis. Naffziger [5] stated that this is most common in the eosinophilic forms of adenoma of the pituitary gland.

Exophthalmos of a unilateral character has been reported as the result of irritation of the cervical portion of the sympathetic nervous system. In these cases the exophthalmos will be accompanied by widening of the palpebral fissure and mydriasis. The causes, as discovered, include disease of the cervical glands, cervical ribs, aneurysm of the large vessels of the neck and neoplasm of the cervical region. The opposite condition, paralysis of the cervical portion of the sympathetic nervous system, with its enophthalmos, should not confuse one and lead to a diagnosis of unilateral exophthalmos in the normal eye.

Unilateral exophthalmos resulting from, or associated with, toxic thyroid disease is most interesting. The bilateral form of exophthalmos associated with toxic thyroid disease is still unsatisfactorily explained from several standpoints. It may occur, first, in connection with an elevated basal metabolic rate and, second, when the basal metabolism is within the normal limits and when all other constitutional symptoms are absent. Zimmerman [6] spoke of this condition as paradoxical exophthalmos and rightly considered it the more serious disorder. Two cases of a severe form of this condition have been observed. In one patient, a one-eyed man, the eyeball, in spite of the several surgical procedures, was completely destroyed by corneal ulceration and through spontaneous rupture. The second of the patients had similar severe bilateral malignant exophthalmos, and there was so much corneal damage that enucleation of both eyes was recommended before the almost inevitable spontaneous rupture occurred. In these cases, as Plummer and Wilder [7] pointed out, the malignant exophthalmos is rather likely to be unilateral, "or if not unilateral, it is likely to affect the eyes unequally." The exophthalmos (bilateral), which occurs with the elevated metabolic rate, may be explained in part, in spite of much controversy, by the spastic contraction of Müller's orbital fibers acting against the pull of the weakened stripped muscle fibers of the four rectus muscles. The absence of mydriasis under these conditions may be accounted for by the observations of Labbé and his associates, as quoted by Plummer and Wilder,[7] that "thyroxin not only has a sympathomimetic action but it also stimulates

5. Naffziger, H. C.: Pathologic Changes in the Orbit in Progressive Exophthalmos, Arch. Ophth. **9**:12 (Jan.) 1933.

6. Zimmerman, L. M.: Exophthalmos Following Operation for Relief of Hyperthyroidism, Am. J. M. Sc. **178**:92 (July) 1929.

7. Plummer, W. A., and Wilder, R. M.: Constitutional Factors with Particular Reference to Exophthalmic Goiter, Tr. Am. Acad. Ophth. **39**:41, 1934.

the parasympathetic elements of the autonomic nervous system." One cannot be convinced by those theories which consider the cause to be an increase in the orbital contents.

In regard to the exophthalmos which occurs in patients who have a low basal metabolic rate Plummer and Wilder [7] made the following statements:

> Why should the external rectus muscles become swollen and hardened, and enlarge to several times their normal thickness? Why should edema develop in the lids when it was absent in the stage featured by a high basal metabolic rate? The evidence from the laboratory suggests that overfunction of the anterior lobe of the pituitary body may play a part in the development of this abnormality. Another possibility is presented by the two-product hypothesis of Plummer,[8] which is based on the assumption that the abnormal product continues to act after the output of the normal product, thyroxin, has been curtailed. The edematous contents of the orbit in this variety of exophthalmos are comparable in some respects to localized subcutaneous areas of mucinous edema, which are found in rare cases of exophthalmic goiter, particularly after thyroidectomy.

Four different cases are sufficient to illustrate various other points in the unilateral form of exophthalmos associated with a high plus basal

Fig. 3.—Unilateral exophthalmos associated with acute toxic thyroid disease.

metabolic rate. The first case, which is illustrated by figure 3, is one of bilateral proptosis in a patient in an acute phase of thyrotoxicosis, but there was a marked difference in the amount of the exophthalmos present in the two eyes. The second case is one of an 11 year old child who was brought in for attention because of unilateral exophthalmos associated with hyperphoria and with diplopia. Her plus basal metabolic rate promptly revealed the true condition. The patient has been under further observation for five years, and the disease has followed the classic course of acute toxic goiter. The unilaterality of the exophthalmos has remained unchanged. The third case is one of long-standing unilateral exophthalmos in a man 45 years of age. He sought relief at the Peter Clinic because of paralysis of the superior rectus muscle and the external rectus muscle of the proptosed eye. Surgical attention corrected his diplopia, and he was advised to seek medical attention because of his

8. Plummer, H. S.: Functions of the Normal and Abnormal Thyroid Gland, in Christian, H. A., and Mackenzie, J.: Oxford Medicine, New York, Oxford University Press, 1920, vol. 3, pp. 846 and 973.

moderately increased basal metabolic rate. At the same time he was under the care of a neurologist, who made a diagnosis of psychoneurosis. The patient was seen at various intervals over a period of three years. Up to his departure from the city he had not shown any great changes, though the constitutional signs of toxic goiter increased at various times. The fourth case is one in which there was a low basal metabolic rate associated with a moderate degree of bilateral exophthalmos (which might ordinarily escape attention), in which dissimilarity was evident in the degree of exophthalmos in the two eyes. Figure 4 illustrates the fourth case. In patients with this condition, also, there is imbalance of the ocular muscles, which seems to be a constant accompaniment of the unilateral form of exophthalmos associated with toxic thyroid disease.

Relative to the microscopic anatomic features of the orbital contents in exophthalmos associated with thyroid disease, various features have been reported which cannot be characteristic of the thyrotoxicosis. There is only one certain fact about these—as Naffziger has pointed out,

Fig. 4.—Bilateral exophthalmos, which is dissimilar in the two eyes, associated with toxic goiter.

"The microscopic pictures of the orbital muscles in myasthenia gravis and in progressive exophthalmos associated with thyroid disease cannot be differentiated one from the other; they are identical." It is unfortunate that while one must acknowledge the presence and the etiology of this condition as established facts, one also must confess to knowing little, if anything, as to the true reasons for the exophthalmos.

TRAUMATIC CONDITIONS

The traumatisms which cause unilateral exophthalmos are not unusual or uncommon, with one exception, one of the last to be presented herein. A history of trauma, emphysema, exophthalmos and impaired ocular motility and the roentgen findings are sufficient for a correct diagnosis in all cases. One must not be misled, however, by a history of a slight degree of causative trauma. Extensive fractures have followed relatively minor accidents, and, conversely, severe traumas have frequently resulted in but few pathologic changes in bone. A case was

reported by Peter [9] in which the injury involved all the ocular muscles except the superior oblique muscle, the trauma being a simple pen-knife stab wound of the orbit, and the only fracture present was a penetrating wound of the lamina papyracea ethmoidalis. (The later history in this case, incidentally, illustrates the reconstructive work and satisfactory results possible in such instances.) Evulsion of the optic nerve and the usual exophthalmos resulting from laceration of the extra-ocular muscles occur from slightly different accidents. In a case of the first mentioned of these two, the condition resulted from a blow to the eye from a broom handle which had been thrown as one would hurl a javelin. The ophthalmoscopic picture and the sudden complete blindness which occurred confirmed the diagnosis (fig. 5). The second of the aforementioned conditions is illustrated by 2 cases in which the injury was rather similar; in the first a child fell on the spout of an oil can, and in the second a boy, somewhat older, fell on the top of a steel picket fence while climbing this during play. The crepitus and the emphysema which accompanied the condition in this case also illustrate findings usually present whenever an orbital fracture is compound, involving the

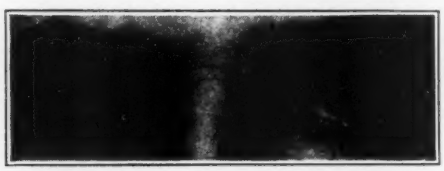

Fig. 5.—Old exophthalmos of the left eye, with divergence, resulting from evulsion of the optic nerve.

nose and especially a nasal accessory sinus. In all these cases the orbital hemorrhage which occurs is likely to be the greatest factor in producing the exophthalmos which immediately develops. Every one who has seen exophthalmos resulting from retrobulbar hemorrhage following the injection of an anesthetic into the retrobulbar space prior to surgical intervention for cataract will agree to this probability.

Trauma sustained at birth can be serious. The injuries which result from the application of obstetric forceps during a difficult delivery are, fortunately, usually temporary. Occasionally the effects of such traumas are permanent. The cranial bones of the vault, when subjected to various different forms of injury, such as contusions, a penetrating wound and even crushing injuries, react with lines of fracture which follow patterns approximately common for all similar injuries. Holloway, as well as various anatomists, demonstrated this. This traumatic factor is simplified, decidedly, it seems, when orbital fractures are considered. The heavy wedge of the zygomatic arch and the curve of the upper

9. Peter, L. C.: Tr. Am. Ophth. Soc. **31**:232, 1933.

outer angle of the frontal arch ordinarily prevent injury to the orbital surface of the greater wing of the sphenoid bone, unless they are themselves fractured. If they are fractured, the sphenoid bone must be injured as well. The floor of the orbit is a rather thin partition separating the orbit from the antrum and continuing medially with the os planum of the ethmoid bone (bone structures similar in density and in structure) and is rather readily fractured from direct blows to the face and to the region of the orbit. The medial wall, at the apex of the orbit, may be included in these lines of fracture. In such instances the fracture is almost certain to continue into the bones at the base of the skull, perhaps into the temporal bone and, when it extends through the sphenoid bone, into the basilar process of the occipital bone. Figure 6 shows such an injury, which resulted from trauma caused by an obstetric forceps, involving the rim of the orbit, with the formation of an encapsulated sequestrum there and with a fracture through the

Fig. 6.—Roentgenogram of the orbit, showing the results of trauma sustained at birth and old fractures of the floor and the outer wall of the orbit.

sphenoid bone into the base of the skull. Additional pathologic changes were a fibrohemangioma of the orbit (removed through a Krönlein resection) and a pulsating intracranial aneurysm of the internal carotid artery which had eroded the right side of the tuberculum sellae and the right clinoid processes. A roentgenogram showed this well (fig. 7 *A*). The pulsating mass was felt in the orbit at the time of the resection of the orbital wall, and following the removal of the subepithelial and orbital hemangioma the pulsation of the intracranial aneurysm was transmitted to the eyeball to a remarkable degree. This pulsation had been present before the resection of the orbital wall, and its cause was correctly determined by both the ophthalmologist and the roentgenologist, but it was startling to see the tremendous increase in the pulsation immediately after the operation. No bruit was present at any time; the fundus showed no pathologic changes, and the fields and central visual acuity were entirely normal. According to Grant, the prognosis in these cases is often grave. Transfrontal craniotomy and/or fractional

ligation of the internal and the common carotid artery done separately or together must be considered. Recently some success has been achieved with high voltage roentgen therapy.

An aneurysm of the internal carotid artery in an adult was diagnosed post mortem by Groff in the case of a patient with left unilateral exophthalmos who was admitted in a semicoma to the Philadelphia Orthopaedic Hospital and Infirmary for Nervous Diseases. The blood-tinged spinal fluid was under a pressure of 500 mm. of water. There were no oculomotor disturbances. A swelling of the left nerve head, measuring from 12 to 14 D., was present when the patient was first seen by Groff and me. This involved the entire retina, giving a picture not unlike that of massive retinal detachment. Death followed shortly. The antemortem diagnosis was intracranial hemorrhage either from a ruptured aneurysm

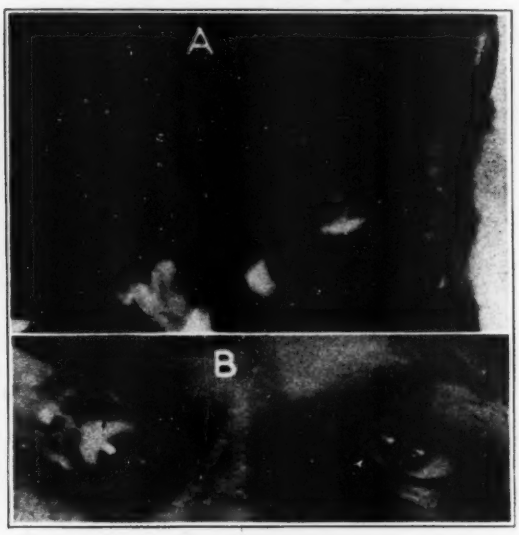

Fig. 7.—*A*, roentgenogram showing the sella turcica in a case of pulsating intracranial aneurysm; *B*, photograph showing the condition in the same case illustrated in *A*, with the lids open. Hemangioma of the orbit is also present.

or due to a neoplasm, with subsequent erosion of one of the carotid arteries, one of the jugular bulbs or one of the cranial venous sinuses. It was thought that the pathologic condition of the fundus might be an extension of the hemorrhage along the sheath of the optic nerve into the eye and might not be due to intracranial pressure. The normal condition of the right fundus seemed to confirm this. Transillumination failed to show any opaque mass in the fundus. De Long's report of the microscopic examination of the eyeball which was enucleated at postmortem examination is as follows:

I am inclined to believe that we are dealing with a choked disk, the result of some intracranial pressure. This is verified by the dilatation of the intra-

vaginal spaces and the edema of the nerve head, with practically empty and compressed blood vessels. There is a questionable exudate associated with the choked disk, which has separated the retina from the choroid. In the postmortem specimen much of this exudate has been washed away, but remnants remain.

Pulsating exophthalmos, that is, exophthalmos due to an arteriovenous aneurysm, either of the carotid-jugular sinus or of the carotid-cavernous sinus, usually has a history of injury preceding the exophthalmos. The typical bruit is present; changes of the fundus are not uncommon, and the bruit, the exophthalmos and the pulsation can be modified by temporary pressure over the carotid artery in the neck. One case of this condition was that of a 26 year old soldier at the Walter Reed Hospital. Enucleation was done because of blindness resulting from accompanying serious corneal damage. This modified the bruit to some degree, but fractional vascular ligation was later necessary because of a late marked increase in this bruit. Peter saw a patient with pulsating exophthalmos without a history of injury—an obese woman of 40. Serologic tests were negative throughout. Fractional ligation was completed on the right and helped to some extent, but for a short time only. Secondary glaucoma, which became absolute, developed in the right eye. In this case the history, which yielded no record of trauma, may not have been accurate, but the patient was positive in her answers to all questions relative to this point. The results of surgical intervention on blood vessels in cases of this condition are often disappointing. Owing to later contralateral anastomoses, the pulsation and exophthalmos may recur. If death does not intervene, contralateral hemiplegia may develop as a result of cerebral softening, and the patient lives a miserable existence.

Relative to the diagnosis of these intracranial vascular conditions Møller [10] studied the records of 555 patients with aneurysm of a large cerebral vessel. Choked disk was not found in any of them. Oculomotor paralysis was common; bulbar protrusion was rare, and pulsation of the eyeball was never seen in the simple (not the arteriovenous) variety. This form was slightly more common in the female than in the male. The classic signs and symptoms of the arteriovenous type of aneurysm include, in addition to the aforementioned, a history of injury; pulsating exophthalmos, and pounding or ringing sensations in the head, i. e., the bruit. It is interesting that the findings in the 4 cases cited in this section should not agree wholly with these findings. Figure 8 illustrates a case of unilateral exophthalmos associated with an arteriovenous aneurysm in a patient of Eagleton's who showed exophthalmos of a high degree. The real problem in all these cases is the

10. Møller, P.: On Intracranial Carotid Aneurism, Klin. Monatsbl. f. Augenh. **66**:909, 1921.

differentiation of an orbital aneurysm from an intracranial aneurysm. Møller's findings must be considered seriously in such possible perplexities.

A foreign body in the orbit is not uncommon. The history is usually clearcut, and a roentgenogram will clear up any doubts which may exist. The history should also reveal the substance of the foreign body. Removal is not essential in the absence of infection or other possible complications, if the foreign body is of steel or iron. Foreign bodies of other materials, however, may cause late complications of a serious nature. Hence their removal may be necessary. Damage to the muscles is likely to be an accompaniment. A pathologic condition of the optic nerve may develop, if not present from the start. Experiences in military surgery have clarified decidedly the treatment of these conditions. Removal should not be attempted in a case of the usual type of this condition, however, without the employment of a biplane fluoroscope. The facts in one such instance satisfied me as to this

Fig. 8.—Unilateral exophthalmos associated with traumatic pulsating arteriovenous aneurysm (Eagleton's case).

when a second unsuccessful attempt was made to remove a piece of copper lying posteriorly and close to the medial wall of the orbit. In this case, however, the exophthalmos and diplopia were largely the result of complete paralysis of the third nerve.

Spontaneous hemorrhage, which was subperiosteal, with unilateral exophthalmos, following a paroxysm of coughing in whooping cough has been reported. A case of this condition was described by Peter.

INFLAMMATORY CONDITIONS

In these conditions the exophthalmos is usually confined to one orbit. It may, however, become bilateral. The exophthalmos may occur simultaneously in each eye, but usually there is quite an interval before the second eye becomes involved. I have seen this occur in a case in which there was an interval of several weeks before the second eye was involved, while the patient was still suffering from an attack of disease of the nasal accessory sinuses (acute or subacute).

In considering the routes through which inflammation can enter the orbit, Eagleton [2] is quoted. The routes are:

> (*a*) from in front, by way of the superior ophthalmic plexus, (*b*) from below, from the pterygoid plexus or through the inferior ophthalmic plexus, or (*c*) medially, from the nose. Endophlebitis of the vessels within the space (*a*) may remain thrombophlebitis of one or the other of the ophthalmic veins . . . or it (*b*) may form a local abscess within the cone, although infection of the retrobulbar space (*c*) is usually but a part of a generalized orbital phlegmon . . A suppurative lesion of the space usually occasions (1) cavernous sinusitis with (2) terminal meningitis. However, the infection of the space itself may arise secondarily from cavernous sinus phlebitis.

Two extensive series of cases may be cited here to illustrate the incidence of inflammatory exophthalmos in cases of sinus disease. Cohen reported a series of 1,517 patients with sinus disease, in 22 of whom inflammatory exophthalmos developed. Birch-Hirschfeld reported on a series of 648 patients with inflammatory exophthalmos; 409, or 60 per cent, showed sinus disease. Among these, the frontal sinus was involved in 30 per cent, the maxillary sinus in 22

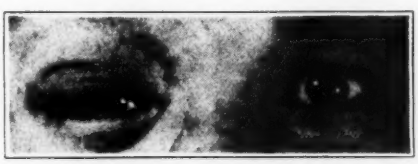

Fig. 9.—Exophthalmos (pseudotumor) associated with disease of the ethmoid sinuses.

per cent, the ethmoid sinuses in 21 per cent and the sphenoid sinus in 6 per cent. Further, in most instances more than one sinus was involved.

Cellulitis and phlegmon do not always continue to the formation of an abscess. Figure 9 illustrates an instance in which no abscess formed. Thorough investigation of the patient's subperiosteal space failed to show any pus. After incision of the periorbita the prolapsed retrobulbar fat appeared bluish, and there was marked vascular dilatation. A hemolytic streptococcus was grown from the culture tubes. The ethmoid cells were broken into (at the same time), and drainage was established from the subperiosteal space to the surface of the skin and through the ethmoid cells into the nasal cavity. At the time of the operation there were: exophthalmos of more than 1 cm., complete immobility of the eyeball, and beginning papillitis in the same eye. For twenty-four additional hours the child continued to be gravely ill. Forty-eight hours later he was definitely on the road to recovery. At no time was there any manifest external drainage from the subperiosteal space; still it is certain that this decompression (if one wishes to call

it this) was the turning point in the child's progress. The signs resembled those of early unilateral thrombosis of the cavernous sinus. As to the diagnosis, the proptosis and immobility of the globe, the papillitis, the roentgen and clinical signs of acute disease of the ethmoid and frontal sinuses, a temperature of the serious septic type and the cytologic features of the blood characteristic of sepsis were conclusive evidence. The condition is somewhat different from that in which an orbital abscess develops early. The clinical signs, in such cases, are not as severe, and the exophthalmos develops rapidly. The changes of the lid are pronounced. Papillitis does occur, but uncommonly. Osteomyelitis of the orbital roof may be present early in cases of this disorder. The condition of a colored child, 15 years of age, illustrates this type of exophthalmos, as well as the salient features in the formation of an orbital abscess. Acute rhinitis was present for five days; the lids began to swell on the fifth day, and the eyeball began to protrude on the seventh day after the onset of the rhinitis. The temperature was septic and moderately elevated. The child was sick but not prostrated by the

Fig. 10.—Orbital abscess resulting from disease of the frontal sinus (case of Simpson, Memphis, Tenn.; from Atkinson, D. T.: External Diseases of the Eye, Philadelphia, Lea & Febiger, 1934; reproduced by permission of the publisher).

intoxication. The fundus was normal. Incision and drainage were done on the night of the eighth day, and the patient was discharged from the hospital as recovered eight days later. Figure 10 illustrates a case of orbital abscess which was cured by this treatment, a form of therapy which is, at the same time, diagnostic.

Exophthalmos associated with an abscess, which develops more slowly, and has even fewer signs of acute sepsis is likely to originate in disease of the frontal sinus and to be accompanied or perhaps caused by osteomyelitis of a frontal bone. An instance of such a condition is a 45 year old man with exophthalmos which had been slowly developing for five weeks and with but few signs or symptoms of acute sepsis. At orbital incision and drainage, an enormous amount of retrobulbar suppuration was found, with considerable osteomyelitic loss of the floor of the frontal sinus at the inner nasal angle. This patient died with generalized meningitis, and with an extradural abscess localized in the

frontoparietal region. In cases in which the frontal sinus is involved, the condition is always serious, and there is a high mortality rate.

Thrombophlebitis of the orbital vein and thrombosis of the cavernous sinus are preceded by orbital cellulitis and by abscess in a rather small percentage of cases. Disease of the nasal accessory sinuses is a frequent cause, but other conditions are as frequently the cause. A Negro of 45 showed the former of these conditions, with subsequent involvement of the cavernous sinus following the appearance of a small pustule at the outer canthal angle. He lived for four weeks, and at one time it was thought that he might recover. A private patient of Peter's died within forty-eight hours after the onset of the orbital signs of sinus thrombosis in the first eye, following dental packing after the extraction of an abscessed root of a tooth, which packing had been retained for twenty-four hours longer than the exodontist had advised.

In cases of classic disease of the cavernous sinus, thrombosis develops rather early in the infection and seems to be due usually to the involvement of the sphenoid sinus. The exophthalmos and the immobility on one side develop in this sequence and not slowly, and thereafter the contralateral orbital involvement usually appears within from twenty-four to forty-eight hours. Eagleton [2] described the thrombosis of the cavernous sinus resulting from aural infection as developing in a slightly different manner. Etiologically, it may retrograde; extending through the petrosal sinus to the cavernous sinus, or it may attack the cavernous sinus directly from diffuse suppuration of the bone marrow within the petrous tip of the temporal bone. In cases of this condition the exophthalmos is often slight and may be transient. These two points are important in considering a case of otitis media in which there are such mild and fleeting symptoms and signs. The changes in the fundus are: paleness of the nerve head, with occasionally some edema of the papilla; contraction or obliteration of the arteries, and normal or engorged veins (even thrombosed veins), and these are combined with impairment of vision, which is often marked. The conjunctival edema is at times pronounced, though it seems that the swelling of the lids is rather less than that seen in cases of orbital phlegmon. The early bilaterality is also of diagnostic value. A positive blood culture is conclusive as to the site of the thrombosis. This condition in the two cases cited is typical of the extremes to which this process may go. The latter of the 2 patients was dead in forty-eight hours. The former lived for more than four weeks. In this patient the bilateral exophthalmos had started to recede; blood cultures were negative, and the patient was free from signs or symptoms indicating meningitis. Signs of bronchopneumonia appeared, and the patient died of extensive pulmonary abscesses.

Exophthalmos is occasionally seen associated with an erysipelatous infection. Eagleton expressed the belief that those cases of proptosis in which erysipelas subsequently develops are primarily cases of phlebitic phlegmon in which the streptococcus causing the phlegmon has been transmuted into that of erysipelas, for it is well recognized that streptococci from an erythematous area of the skin in a person with scarlet fever may be the cause of phlegmonic cellulitis or may even cause osteomyelitis. The reverse of this process may often occur. A case in a child of 5 years of age illustrates this well. The patient was seriously ill with erysipelas for several days, when exophthalmos of the right orbit suddenly developed, which was followed in twenty-four hours by a similar condition of the left orbit. The first and natural conclusion was that thrombosis of the cavernous sinus had occurred. Antistreptococcus vaccine was administered, and the patient made a fairly rapid and uneventful recovery. The exophthalmos present, however, receded more slowly than did the other general symptoms. Some edema of the papillae of the optic nerves was present early in the course of this complication. It is rather likely that orbital thrombophlebitis, rather than frank phlegmon, was the immediate cause.

Tenonitis has been described by Shoemaker [11] as a cause for unilateral exophthalmos. It may be a part of orbital cellulitis or separate from this. In such instances it may be prodromal to panophthalmitis, and as such it is to be seriously considered. Suppurative tenonitis has been seen following surgical intervention on muscles, resulting in the loss of the eyeball. The symptoms of proptosis, chemosis, pain on motion, and restricted motion are present. Zentmayer [12] reported a case of tenonitis complicating typhoid fever. Shoemaker [11] stated that tenonitis has occurred after diphtheria and influenza. Idiopathic tenonitis is allied, it seems, to rheumatism and to gout. As he (Shoemaker) stated, "These diseases are often responsible for episcleritis, with which certain cases of tenonitis may be confounded. Ordinary care in the examination should make the differential diagnosis clear."

Syphilitic periostitis and tuberculous periostitis both cause exophthalmos of moderate degree. Periostitis and osteomyelitis caused by other organisms also occur, though uncommonly. The position of the diseased bone, the roentgen findings, the serologic reactions and other allied signs will be sufficient for a correct diagnosis. The chronicity of syphilitic periostitis and tuberculous periostitis is, perhaps, their outstanding feature. One case is illustrative. A young man had exophthalmos associated with a chronic pathologic condition of the lacrimal

11. Shoemaker, W. T.: Disease of the Orbit, in Ball, J. M.: Modern Ophthalmology, ed. 3, Philadelphia, F. A. Davis Company, 1913.

12. Zentmayer, quoted by Shoemaker.[11]

sac. Dacryorhinocystotomy revealed tuberculous infection of the lacrimal sac, tuberculous osteomyelitis and formation of a sequestrum in the medial wall of the orbit. Recovery was ultimately complete, but the patient was under rather active observation for almost a year. Careful roentgen studies and injections of iodized poppy-seed oil 40 per cent into the lacrimal sac should have been done prior to any surgical intervention.

Engelking [13] described exophthalmos resulting from hyperplastic tuberculous lymph nodules, which he called tuberculoma, and expressed the belief that it probably originated from a condition of the conjunctiva. Exophthalmos of this type is, however, usually bilateral, though unequal in degree. Engelking stated that the picture was similar to that seen in pseudotumor of the orbit. In the case that he described the condition demonstrated a relationship to true lymphomatosis, a still closer relationship to inflammatory pseudotumor of the orbit and, finally, a relationship to the tuberculous processes and to other conditions resembling those which are grouped under the Mikulicz symptom complex. Relative to the diagnosis of periostitis and tenonitis, Shoemaker [11] said:

> As both have many common symptoms . . . the differential diagnosis is generally not difficult. The boring deep seated pain, with nocturnal exacerbations, together with external signs, serve to implicate the periosteum in the inflammatory process. Tapping with the finger around the orbital margin, so as not to disturb the orbital contents, will serve often to locate the affection in the bones. If this can be done without pain, the bone or the periosteum is not involved. Vice versa, if gently pushing back the eyeball, with just sufficient force to reach the soft parts only, caused marked pain, we probably have to do with tenonitis or cellulitis. Tenonitis seems to cause the greater pain of the two. Syphilitic periostitis is generally a tertiary manifestation, but we should remember that it may, also, be found in the complex of the secondaries.

The paralysis of the third nerve involving the globe is likely to be periosteal in origin when the levator muscle continues to function. Syphilitic periostitis is more common in the roof of the orbit (the suppurative forms resulting from disease of the frontal sinus being excluded) and at the outer upper margin and rim of the orbit. The tuberculous form of periostitis selects other positions in the greater number of cases.

In Dunbar Roy's [14] case of orbital tuberculosis the condition was quite different. There was intense protrusion of the entire orbital contents; the bulbar conjunctiva was edematous and thickened, and palpation revealed a mass which seemed to fill the entire orbit, which was tender, and generally firm, but with a suggestion of fluctuation present.

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13. Engelking, E.: Ueber symmetrische Tuberkulome der Orbita, Klin. Monatsbl. f. Augenh. **70**:100 (March 10) 1923.

14. Roy, Dunbar: Tuberculoma of the Orbital Cavity, Arch. Ophth. **52**:147 (March) 1923.

Vision was destroyed. There was no glandular involvement about the body, and no history of tuberculosis in the family existed. Exenteration of the orbit confirmed the diagnosis.

In Rogers'[15] case the condition was characteristic of the syphilitic form of periostitis. The patient was a 60 year old man. There were exophthalmos, the classic pains, thickening of the orbital walls, absence of inflammatory changes, and accompanying uveitis. The Wassermann reaction was positive. Antisyphilitic treatment resulted in a negative serologic reaction and recession of all the symptoms and signs except proptosis of 5 mm., which was due to a permanent deposit of bone characteristic of syphilitic periostitis.

Pseudotumor is a term occasionally used for slowly developing exophthalmos caused by a low grade nonmycotic infection due probably to an unidentified organism. Shoemaker[11] reported a case of such a condition in detail and gave recommendations for treatment. The case was carefully studied also by de Schweinitz. Shoemaker stated: "In spite of invitations to exenterate the orbit, to enter the orbit, and to enter the antrum, all of which had academic merits but promised nothing beneficial to the patient, I continued with conservative and supportive treatment." De Schweinitz felt that the true nature of this lesion remained a matter of opinion, but the practical results were satisfactory.

Fry recently presented such a case before the Pennsylvania State Medical Association. The report of the pathologic examination of the enucleated eye is as follows:

> The section shows old hyaline and fibrous tissue in abundance and some recently formed blood vessels. These are foci of lymphoid tissue well surrounded by connective tissue. There seems to be no acute process going on. This is not an actively malignant growth. It suggests chronic granulation tissue. The lymphoid inclusions suggest the possibility of Mikulicz' disease but are much smaller than in the one acceptably diagnosed case seen by the pathologist.

Figure 11 is the photomicrograph of a section of the diseased tissue of the growth in Fry's case.

Exophthalmos has been seen, as Foster[16] stated, after a penetrating wound of the orbit, associated with stiffness of the neck, convulsions, facial palsy and spasms of the throat, due, as one would surmise, to tetanus.

Acute exophthalmos may be symptomatic of an abscess in or about the lacrimal gland or may be due to acute dacryo-adenitis resulting from invasion by pyogenic organisms.

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15. Rogers, R. M.: Periostitis of the Orbit. Am. J. Ophth. **7**:782 (Oct.) 1924.

16. Foster, Matthias: Diagnosis from Ocular Symptoms, New York, Rebman Co., 1917.

Exophthalmos resulting from chronic sinus disease is not common. Dowman's [17] case and St. Clair Thompson and M'Ilraith's [18] case of mucocele of the frontal sinus, Ferreri's [19] case of pulsating mucopneumatocele of the frontal sinus, Reverchon and Worms' [20] and Bower's [21] cases of mucocele of the ethmoid sinuses, Hajek's [22] case of mucocele of both the frontal sinus and the ethmoid sinuses and Peter's [23] case of exostosis or chronic periostitis of the ethmoid sinuses are all inclusive and classic examples of these somewhat rare complications. Figure 12 is a recent roentgenogram showing a mucocele of the ethmoid sinus and illustrates well a statement made previously in this paper to the effect that roentgen diagnosis plus careful clinical investigation by a competent rhinologist is necessary but adequate in cases of unilateral exophthalmos.

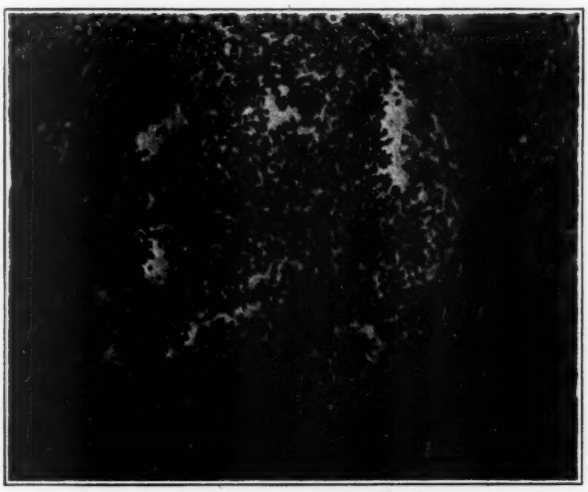

Fig. 11.—Photomicrograph of a section of the growth in Fry's case of pseudotumor of the orbit.

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17. Dowman, C. E.: Giant Mucocele of the Frontal Sinus, J. A. M. A. **81:** 1014 (Sept. 22) 1923.

18. Thomson, St. Clair, and M'Ilraith, C. H.: Mucocele of the Frontal Sinus, J. Laryng. & Otol. **38:**365 (July) 1923.

19. Ferreri, G.: Muco-pneumatocèle "géant" bilatéral des sinus frontaux, Arch. internat. de laryng. **28:**973 (Sept.-Oct.) 1922.

20. Reverchon, L., and Worms, G.: Mucocèle fronto-ethmoidal, Arch. internat. de laryng. **28:**682 (June) 1922.

21. Bower, R. L.: Mucocele of the Ethmoid, Am. J. Ophth. **7:**218 (March) 1924.

22. Hajek, M.: Mucocele der rechten Stirnhöhle und des rechten Siebbeinlabyrinthes, Monatschr. f. Ohrenh. **58:**389 (May) 1924.

23. Peter, L. C.: Presentation of a case before the staff of the Graduate Hospital of the University of Pennsylvania, Oct. 12, 1932.

Cholesteatoma has been reported of such an extensive size as to break through the roof of the orbit and cause proptosis. Wolff [24] reported a study of the 18 cases which up to that time had been described in the literature. The growth originates from the diploe of the frontal bone as a result of chronic inflammation in the sinus. The earliest symptom is pain due to pressure, to be followed later by exophthalmos, swelling of the lids and choked disk. Wolff stated that roentgen diagnosis would be difficult except for the fact that there may be destruction of bone and the formation of fistulas. The frequent description of this growth, cholesteatoma, as a neoplasm is incorrect, as Knapp stated, and pathologists seem to be abandoning the belief that it is a form of tumor, i. e., neoplastic in origin.

Actinomycosis, anthrax, trichinosis, hyatid cyst and mycotic pseudotumor have been repeatedly reported, though not commonly, as the cause of unilateral exophthalmos. The diagnosis in the first of the conditions

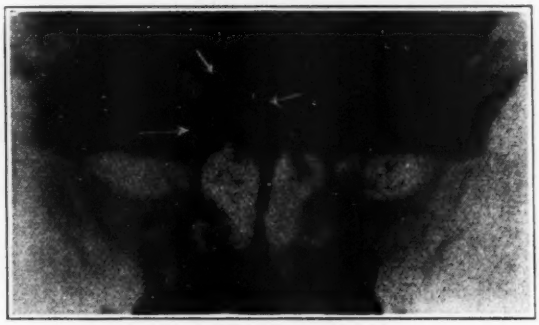

Fig. 12.—Roentgenogram showing a mucocele of the ethmoid sinuses in a patient with unilateral exophthalmos.

mentioned should be the simplest, because of the general symptoms, as well as the local symptoms of abscess formation, the history of the patient and the laboratory studies. Studies of the cytologic features of the blood, and the orbital pains, plus a history of the characteristic muscular pains, will assist in cases of the third-mentioned condition. In the two last-mentioned conditions, however, the diagnosis depends largely on resection of the orbital wall, plus, perhaps, the elimination of every other possibility in any case under investigation. In cases of infection caused by Streptothrix the diagnosis is made on the basis of the symptoms of subacute or acute infection, suppuration, the occupation of the patient, perhaps, and the microscopic and macroscopic observations. The diagnosis of anthrax is based wholly on the acute suppurative process, the occupation of the patient (this being especially

24. Wolff, H.: Ueber ein Cholesteatom der Stirnhöhle, Beitr. z. klin. Chir. **130**:215, 1923.

important) and the gross and microscopic laboratory observations. Shipman presented a case of this condition before the College of Physicians of Philadelphia, in which the classic signs and symptoms of anthrax were present. In Pascheff's [25] case of actinomycotic tumor of the orbit the signs and symptoms were equally characteristic. The patient had unilateral exophthalmos, with ptosis of recent duration, and a history of orbital injury nineteen years before. Several abscesses, with fistulas which appeared six years later, led from the skin of the forehead in the neighborhood of the orbital rim. The cultures showed Streptothrix. These fistulas healed after several months of medication with potassium iodide. Two years later the condition recurred and was most severe, leading to complete immobility of the proptosed eyeball. This time the tumors were removed by surgical intervention, with complete and rapid cure. These mycotic pseudotumors of the orbit may continue without fistulas for several years. In this form they are not extremely rare. González' [26] patient presented paralysis of the third nerve, exophthalmos, mydriasis and paralysis of accommodation, cutaneous and corneal anesthesia and corneal ulceration with hypopyon. If the correct diagnosis is not made, the condition will continue to complete immobility of the eyeball, blindness from atrophy of the optic nerve and emaciation of the patient, with the development of multiple fistulas as the terminal stage.

Rather recently, O'Brien and Leinfelder [27] reported a case of a somewhat different condition, in which surgical exploration was without success, and death occurred from thrombosis of a cavernous sinus. In this case cultures positive for Streptothrix were obtained from the brain at the necropsy. Matthias Foster [16] discussed the symptomatology in a case of trichinosis of the ocular muscles, which he diagnosed largely on the basis of oculomotor paralysis of recent duration which could not be ascribed to any lesion of the afferent nerves, the presence of a doughy edema of the lower lid and other general symptoms of this infection. Hydatid cyst is due to the echinococcus, and cystic degeneration may be due to Cysticercus cellulosae. Both the conditions just mentioned are rare, especially the second. Berlin, Parsons, Aniceto-Solares,[28] Lagrange, L'Heureux and Wood [29] have written about these unusual

25. Pascheff, C.: Ueber eine Streptothrix-Strahlenpilz-Geschwulst der Orbita, Ztschr. f. Augenh. **47**:109, 1922.

26. González, J. de J.: Tumor micósico de la órbita, Rev. cubana de oftal. **4**:76, 1922.

27. O'Brien, C. S., and Leinfelder, P. J.: Unilateral Exophthalmos, Am. J. Ophth. **18**:123 (Feb.) 1935.

28. Aniceto-Solares: Les kystes hydatiques de l'orbite, Arch. d'opht. **39**:406 and 491, 1921.

29. Wood, D. J.: Hydatid Cysts of the Orbit, Brit. J. Ophth. **9**:4 (Jan.) 1925.

conditions. Wood was so fortunate as to observe 3 cases, which he described. He stated that the diagnosis is uncertain, apart from positive results of examination of material removed by aspiration, but the negative Wassermann reaction, the absence of inflammation, the frequent attacks of blindness without the presence of a pathologic condition of the fundus, and a palpable tumor are all suggestive, especially if the patient lives or has lived in a land where hydatid disease occurs. According to Wood's experience, these cysts may lie either free in the orbit or within the muscle zone.

The last of the conditions to be considered in this section of inflammatory causes is xanthomatosis of the orbit allied to the Schüller-Christian syndrome—a syndrome of exophthalmos associated with diabetes insipidus and with large defects in the bones of the skull (Wheeler [30]). The Schüller-Christian syndrome occurs essentially bilaterally, but because of the allied xanthomatosis, which follows, it seems proper to mention it here. The condition is similar to cholesteatoma in the indefiniteness of its origin. Knapp,[31] Heath,[32] Pincus [33] and others have written relative to this disease. Xanthomatosis of the orbit, a part of the syndrome just mentioned, has been described by Knapp [31] as a unilateral, tumorous, hyperplastic condition of the reticulo-endothelial cells, resulting from the infiltration of lipoids in excess of the body fluids. Unilateral exophthalmos, accompanying neuritis of the optic nerve, rarefaction of the roof of the orbit and the presence of a palpable mass in the orbit, apparently continuous with the frontal bone, were the characteristic features in Knapp's case. Evisceration of the orbit is alone confirmatory of the diagnosis.

DISEASES OF THE BLOOD, THE LYMPH AND THE HEMATOPOIETIC SYSTEMS

Diseases of the blood, the lymph and the hematopoietic system are responsible for many cases of unilateral and bilateral exophthalmos. Rickets, scurvy and hemophilia are the first to be mentioned. These conditions result in subperiosteal hemorrhages, deep in the orbit, which occur abruptly and are accompanied by hemorrhagic extravasations into the skin of the upper and the lower lids, especially the lower lids.

30. Wheeler, J. M.: Schüller-Christian Disease (Xanthomatosis), Arch. Ophth. **11**:214, (Jan.) 1934.

31. Knapp, A.: Xanthomatosis of the Orbit, Arch. Ophth. **11**:141 (Jan.) 1934.

32. Heath, P.: Ocular Lipoid Histocytosis and Allied Storage Phenomena, Arch. Ophth. **10**:342 (Sept.) 1933.

33. Pincus, F.: Ueber „Cholesteatom" der Orbita, Klin. Monatsbl. f. Augenh. **90**:145 (Feb.) 1933.

Otherwise, the general symptoms which identify these conditions should be sufficient for making a correct diagnosis.

In regard to these conditions, some rather important dictates relative to unilateral exophthalmos should be emphasized. The condition must be investigated immediately, certainly before any surgical intervention is considered, by the following: (*a*) roentgenograms taken early; (*b*) studies of the basal metabolic rate; (*c*) the Wassermann test; (*d*) studies of the nose and throat; (*e*) careful studies of the blood and of the cytologic features of the blood.

Lymphosarcoma (lymphoblastic), lympho-endothelioma, acute and chronic leukemia and, possibly, Mickulicz' disease are allied conditions. With the exception of the leukemias, the blood picture is not especially characteristic. Leinfelder and O'Brien [34] stated: "Characteristically, all types of lymphoma show progressive, painless enlargement of the cervical lymph nodes, increase in the size of the spleen and liver, and in the later stages, secondary anemia and cachexia." These are common. With the exception of the signs, the diagnosis must be based, usually, on observations at postoperative or postmortem microscopic examination. In cases of lymphosarcoma, the lids are usually involved by nodules; the exophthalmos is apparently of moderate degree, and age seems to have no relationship to the condition. Leinfelder and O'Brien [34] reported 3 cases of lympho-endothelioma, in 2 of which the patient had unilateral exophthalmos. They stated the belief that lympho-endothelioma is a rare condition, similar in the general symptomatology to Hodgkin's disease. In 2 of their patients cranial extensions developed, and a third patient presented a Horner's syndrome resulting from enlargement of the cervical lymph nodes. The diagnosis depended wholly on the microscopic picture of the tumor. Figure 13 illustrates one of their cases of unilateral exophthalmos associated with this malignant lymphoma of endothelial nature.

Acute and chronic leukemia are not commonly accompanied by exophthalmos. In 96 cases of lymphatic leukemia reviewed by Reese and Guy,[35] 2 per cent of the patients showed exophthalmos. The blood picture in this condition is characteristic. One of Reese and Guy's patients had a count of 160,000 white cells per cubic centimeter, 94 per cent of them being small lymphocytes. In cases of this condition retinal hemorrhages are common; the retinal vessels have a pale, even milky, appearance, and there is often a soft edematous swelling of the lids. Figure 14 illustrates one of O'Brien's cases of this condition.

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34. Leinfelder, P. J., and O'Brien, C. S.: Lymphoma of the Eye and Adnexa, Arch. Ophth. **14**:183 (Aug.) 1935.

35. Reese, A. B., and Guy, L.: Exophthalmos in Leukemia, Am. J. Ophth. **16**:718 (Aug.) 1933.

Recently, a case of Adler's, from the Wills Hospital, illustrated certain difficulties in the diagnosis of this condition. The case was one of unilateral exophthalmos in a woman aged 65. The fundus showed no characteristic pathologic changes. The white cells of the blood numbered 20,000 per cubic centimeter, with 28 per cent polymorphonuclears and 68 per cent large adult and immature lymphocytes. Two pathologists considered the case to be one of acute lymphoblastic leukemia, while two others called it one of acute infectious mononucleosis. The cause for the confusion is not unreasonable, but the patient was not definitely benefited thereby.

Cases of Mickulicz' disease, it seems, may belong to the cases of the leukemias. This condition consists of chronic bilateral enlargement

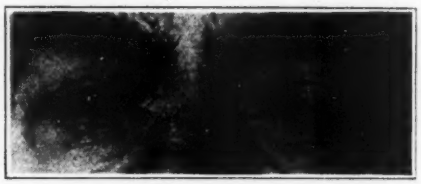

Fig. 13.—Unilateral exophthalmos caused by malignant lymphoma (O'Brien and Leinfelder).

Fig. 14.—Unilateral exophthalmos associated with acute lymphatic leukemia (O'Brien).

of the lacrimal and the salivary glands in which the characteristic microscopic observation is marked infiltration by lymphocytes, and also by endothelioid and giant cells, which are occasionally present. Wolff [36] stated that "the etiology is much disputed and probably varies in different cases."

Exophthalmos has been seen in association with Hodgkin's disease, though, considering the relative frequency of the latter condition, associated proptosis is rare. A case of Hodgkin's disease was observed at the Walter Reed Hospital, in which, after cachexia had advanced rather far, unilateral exophthalmos developed. The eye in which it occurred

36. Wolff, E.: Pathology of the Eye, Philadelphia, P. Blakiston's Son & Co., 1935.

was on the opposite side of the body to that in which there was the greatest amount of enlargement of the cervical lymph nodes. The possibility of a Horner's syndrome contralaterally was eliminated by the finding of a palpable mass in the outer, superficial, angle of the orbit. Leinfelder's and O'Brien's [34] patient had bilateral exophthalmos, with a nodule adherent or attached to each external rectus muscle. It is likely that this condition was similar to that I observed. The microscopic picture of any one of the enlarged lymph nodes is classic, though Hodgkin's disease has been misdiagnosed at various times as tuberculous adenitis.

Myeloblastoma and myelogenous leukemia are similar to the leukemic conditions except for the presence of premyelocytes and myelocytes in the blood stream. The white cells usually number over 100,000; progress is rapid, and massive hemorrhages occur into the tissues of the

Fig. 15.—Unilateral exophthalmos associated with myelogenous leukemia (Reese and Guy).

orbit. The blood picture cannot be mistaken. The patient whose case was reported by Reese and Guy [35] had 510,000 white cells per cubic centimeter, Burchell's report in their case under the heading "differential count" being "Myeloid series over 90 per cent and morphologically that of an extremely embryonal type of cell . . . About 5 per cent seem to be differentiating into the eosinophile type." Figure 15 illustrates one of their cases. The massive late hemorrhages are rather well seen. These tumors, when green and infiltrating, are spoken of as chloromas. The condition in Barnert's [37] case was characteristic. In this case the disease advanced into the bones of the skull and proved fatal in one month. In regard to tumors, Piney [38] stated: "The mode of infiltration of the tissue does not seem to differ from that characteristic of malignant tumors in general." The blood picture in his case consisted of 85 per

37. Barnert, C.: Report of a Case of Chloroma of the Orbit, Arch. Ophth. **53**:454 (Sept.) 1924.

38. Piney, A.: Diseases of the Blood, Philadelphia, P. Blakiston's Son & Co., 1928.

cent myeloblasts and 15 per cent premyelocytes. Figure 16 illustrates a case of O'Brien's showing an orbital tumor. The patient had a normal blood picture, but the microscopic diagnosis was that of an undifferentiated tumor of the hematopoietic system, and roentgenograms showed a small area of rarefaction in the medulla of one tibia.

SPACE-TAKING ORBITAL LESIONS

Relative to the space-taking lesions which appear in the orbit, there are five general classes to be considered. The first is true cyst; the second, gumma; the third, a benign neoplasm; the fourth, a malignant neoplasm which is primary in the orbit or in the eyeball and which, by extension through the globe, invades the orbit, and the last, an orbital metastatic neoplasm secondary to a tumor of the nasal accessory sinuses, the liver, the kidney, the adrenal glands or some other organ. All these space-taking lesions have as a common symptom slowly developing exophthalmos, usually with but few if any inflammatory changes. Changes in the fundus are rare save in those patients with primary

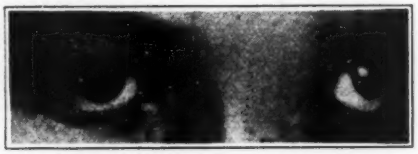

Fig. 16.—Myeloblastoma of the orbit (O'Brien).

retinal, choroidal or papillary involvement, and the age limits are roughly individual and peculiar to certain conditions. Less common signs and symptoms are: duration of the exophthalmos, roentgen changes in the bones of the orbit and changes in the normal density of the orbital contents, various oculomotor disturbances, the direction of the proptosis, inflammatory signs and the presence of a primary neoplasm in some extra-orbital portion of the body.

Pseudotumor is again mentioned here, for though it is inflammatory in origin and neither cystic nor neoplastic, its inclusion herein is a logical addition, by reason of the name by which it is known. (See the section on inflammatory conditions of the orbit.)

The first class will include dermoid cyst and sebaceous (retention) cyst. One of the classic examples of the latter is the case of an 18 year old girl with exophthalmos which started at the age of 7 years. In the previous two years of the patient's life a mass could be palpated constantly in the orbit. There was no oculomotor or visual disturbance, but diplopia had developed recently. A Krönlein resection of the orbital wall showed an orbital cyst containing rolls of hair and much sebaceous material, the internal wall of the cyst being adherent to the sheath

of the optic nerve. Complete removal was accomplished save for that portion which was attached to the neural sheath of the optic nerve. The length of time the exophthalmos was present, its onset at an early age, its slow development and the absence of any other pathologic signs were sufficient for the diagnosis. A roentgenogram showed a mass in the orbit, in the retrobulbar space, but this was not of sufficient density to make one consider fibroma or osteoma. Lipoma might have been considered from the standpoint of the age of the patient, the development of the growth and its duration, but the noncompressibility of the palpable tumor, the direction of the proptosis (down and in) and the density of the roentgen shadow made cyst the more probable diagnosis. Following the surgical removal of this cyst, further investigation into the history (obtained from the patient's uncle, a physician) revealed a significant fact. Five years prior to the resection of the orbital wall, a rhinologist in the patient's place of residence had evacuated a cyst, which contained sebaceous material, from the ethmoid region of the same (left) side. This had ruptured spontaneously into the patient's middle nasal meatus. We were inclined to consider that cyst, which was incompletely removed at this time, as the same cyst which was removed subsequently.

An interesting oil cyst, occurring in the retrobulbar and subperiosteal region, was described in 1923 by Knapp,[39] with a complete pathologic report, the contents being of such a material that one might believe the growth belonged to the group of dermoid tumor. According to Knapp and, even earlier, to Lagrange,[40] this type of cyst has a predilection for the prelacrimal region within the orbit.

A similar cyst was seen recently, in Baer's service at the Wills Hospital. The patient was operated on by Rankin. The contents of the sac were identical to those found in the cyst described by Knapp, and the cyst was in an identical location. In fact, in this case the pedicle of the cyst was adherent to the prelacrimal periosteum, and the cyst had eroded a marked depression into the external surface of the supraorbital region of the frontal prominence.

Gumma of the orbit is apparently becoming much more rare than formerly. Kemp,[41] in discussing syphilis of the orbit, gave a detailed description of 4 cases of this condition. All the patients had acquired syphilis some years previously; all had pain in the affected eye, which was worse at night, and unilateral exophthalmos, with paralysis of some of the extra-ocular muscles; some even had complete ophthalmoplegia externa, and all showed abnormal pupillary reactions on the affected

39. Knapp, A.: Oil Cyst of the Orbit, Arch. Ophth. **52**:163 (March) 1923.

40. Lagrange, quoted by Knapp.[39]

41. Kemp, J. E.: Syphilis of the Orbit, Arch. Dermat. & Syph. **8**:165 (Aug.) 1923.

side. Three of the patients showed fundic pathologic changes of the nerve head. Kemp expressed the belief that the pain was the most characteristic symptom in cases of this condition. In addition to those cases of unilateral exophthalmos in which there is a true gumma, in other cases also syphilis may be the cause of exophthalmos—with many of the other symptoms just described due to periostitis and, or with, osteitis. In one case, which was observed in Peter's service, at the Graduate Hospital, the condition was characteristic. The patient was a 22 year old colored girl, with a positive Wassermann reaction, with the characteristic pains described by Kemp and with exophthalmos of 1 cm. in the right eye, accompanied by complete paralysis of the third nerve. Each fundus showed a pathologic condition of the blood vessels unusual

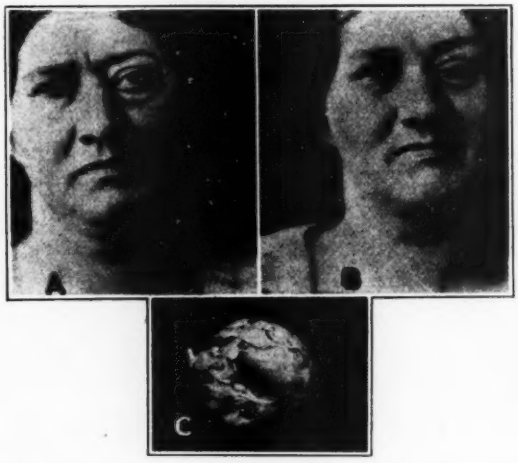

Fig. 17.—Fibroma of the orbit (Benedict's case). *A*, appearance of the patient before removal; *B*, appearance of the patient after removal; *C*, the tumor.

for a person of the patient's age. Recovery, with the patient under antisyphilitic treatment continued for three months, was uneventful.

Of the benign tumors reported as a cause of unilateral exophthalmos, fibroma, lipoma, osteoma and osteo-fibroma, and neurofibroma will be discussed first. Fibroma seems to be made up of white connective tissue, showing some hyaline degeneration, and mitotic figures are extremely rare. It may recur, however, if not completely removed. The condition in the case of Stokes and Bowers [42] is typical of this rather uncommon tumor. Benedict's case [43] (fig. 17 *A*, *B* and *C*) is detailed here. The patient, 34 years of age, had exophthalmos of 14 mm. in the left eye, due to a tumor, without diplopia and with a normal

42. Stokes, W. H., and Bowers, W. F.: Pure Fibroma of the Orbit, Arch. Ophth. **11**:279 (Feb.) 1934.

43. Benedict, W. L.: Personal communication to the author, September 1936.

fundus. Removal of the tumor was achieved through an external, lateral periorbital incision. The tumor was 2.5 by 2 by 3 cm. in size, encapsulated, slightly vascular, and pigmented on the anterior end. There were no large vessels and no firm attachments to the orbit.

Relative to osteoma, it is at times difficult to decide whether it is due to hyperplasia or heteroplasia of bone. Certainly, the exostoses one sees in chronic disease of the ethmoid sinuses are of the latter type—due to chronic inflammation or to chronic traumatic insult. On the other hand, true osteoma due to hyperplasia of bone appears in the orbit in situations where it is unlikely that the tumor can be due to preexisting inflammation. The roentgen picture shown in figure 18 is typical of that of early but definite osteoma. This heteroplastic form of bone formation is well illustrated by the case of pseudo-osteoma reported by Van Duyse and Moret.[44] The patient had marked exophthalmos, which was corrected surgically by the removal of two different tumors, one in the retrobulbar space and the second in the temporal fossa. The

Fig. 18.—Roentgenogram showing osteoma of the orbit.

diagnosis of the orbital mass, based on microscopic examination, was calcified fibrolipo-epithelioma, and that of the mass in the temporal portion of the cranium was calcified epithelio-osteoma.

Neurofibroma, or fibroma molluscum, of the plexiform variety, appears rather commonly on the face and in the orbit. The tumor is not neurogenic but is derived from connective tissue, probably from the sheath of Schwann. Figure 19 shows a typical neurofibroma of the orbit. Not only do patients with this condition have unilateral exophthalmos resulting from the retrobulbar growth of the new tissue, but the tumor in many instances causes a deformity of the floor and roof of the orbit. This was so in each of the 4 different cases observed by me. The possibility that fibroma may become sarcomatous later is illustrated well by Zentmayer's[45] case of osteosarcoma. His patient had

44. Van Duyse, D., and Moret: Pseudo-ostéome de l'orbite, Arch. d'opht. **41**:129 (March) 1924.

45. Zentmayer, W.: Osteosarcoma of the Orbit, with Unusual Surgical Complications, Am. J. Ophth. **9**:736 (Oct.) 1926.

an indefinite history of mild trauma six years earlier. The exophthalmos developed slowly for four years, then abruptly began to advance rapidly. The true diagnosis of the type of tissue present had to be made microscopically.

Myxoma and chondromyxoma have both been reported as the cause of unilateral exophthalmos. The first of these consists of cells of an embryonal type, grows very slowly and occasionally becomes sarcomatous. The chondroma has typical fetal cartilage cells and, occasionally, cartilage with stellate cells. It is at times myxomatous as well. This tumor is encapsulated, hard and nodular. It seems that when the encapsulation becomes imperfect the growth spreads rapidly, though it does not metastasize. Ewing [46] reported a case of this condition in detail. Klionsky [47] reported a case of myxoma of the orbit and of the frontal sinus of such a size that enucleation of the eye was necessary to remove the entire mass. Considerable destruction of bone was present in the roof of the orbit.

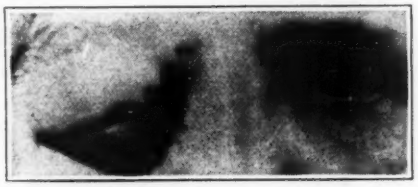

Fig. 19.—Neurofibroma of the orbit.

Cylindroma was at one time thought to be endothelial. Now it is more commonly considered as epithelial. The cells are arranged in cylindric spaces which are filled with hyalin. This type of tumor occurs most commonly as the ordinary mixed cell tumor of the parotid gland. Zentmayer [45] cited a case of this variety as connected with the lacrimal gland, and Agnes Baron [48] reported a case of this condition, giving in great detail the clinical and microscopic features. Her observations permitted her to consider the lacrimal gland as an altered salivary gland and to designate this type of tumor as prognoblastoma.

Psammoma is truly endothelial, consisting of whorls of endothelial cells with areas of centrally disposed laminated calcification. Karsner [49]

46. Ewing, J.: Neoplastic Diseases, ed. 3, Philadelphia, W. B. Saunders Company, 1928.

47. Klionsky, G.: Displacement of One Eyeball Due to Myxoma of the Frontal Sinus, Lancet **1**:126 (Jan. 17) 1925.

48 Baron, Agnes: Zur Stellung der Orbitalcylindrome im onkologischen System als Progonoblastome, Arch. f. Ophth. **113**:31, 1924.

49. Karsner, H. T.: Human Pathology, Philadelphia, J. B. Lippincott Company, 1926.

stated that mitotic figures are not uncommon. This condition is rare and seems to be connected with chronic nasal disease. In the case described by von Eicken [50] the patient showed roentgenographic signs of disease of the ethmoid sinuses, with marked shading of the ethmoid and frontal sinuses. The exophthalmos had been developing over a period of six years. Eicken reported the findings at operation as follows:

> Large masses of the tumor tissue were removed, and it was discovered that all the dividing walls of the ethmoid bone and the anterior wall of the sphenoid sinus were lacking. The tumor mass crunched under the spoonlike sand. Extensive hemorrhage prevented a reliable radical extirpation. Sixteen days later, following cleansing and cocainization of the nasal cavity, examination revealed a firm tumor, which nearly filled the cavity, in the depths of the inferior nasal passage. Operation demonstrated this tumor to be a firm clublike swollen structure containing granulations and vestiges of tumor. Healing occurred in eleven days.

Adamantinoma is a cystic tumor which arises from the paradental epithelial débris. Sooner or later the capsule of this tumor ruptures, and the disease extends rapidly into the antrum, the orbit and the cranial cavity. Ewing [46] reported 2 instances of such a condition. In figure 20, *A* and *B* are a photograph and a roentgenogram, respectively, illustrating O'Brien's case of adamantinoma of the orbit.

Lymphangioma and hemangioma are rather uncommonly the cause of unilateral exophthalmos. They consist of a tangled network of dilated blood vessels or lymph vessels. They are usually congenital, tend to increase in size and may become malignant through sarcomatous changes. Hemangioma is usually bluish and is, perhaps, the more common of the two. In the case reported by Franklin and Cordes [51] the tumor is typical of lymphangioma. Marked proptosis was present. Exploratory operation through the conjunctival cul-de-sac showed a cyst with clear watery contents, which was removed by resection of the orbital wall three months later. The proptosis had started in the early months of the child's life. The mass could be palpated in the orbit, was not tender, was freely movable and fluctuated somewhat. Microscopic examination of the tissue was necessary for a correct diagnosis. Ring [52] and Jones [53] each reported interesting cases of orbital heman-

50. von Eicken, C.: Ueber ein Psammom des Siebbeins und der Keilbeinhöhle, Schweiz. med. Wchnschr. **52**:495 (May 25) 1922.

51. Franklin, W. S., and Cordes, F. C.: A Case of Orbital Lymphangioma, J. A. M. A. **83**:1741 (Nov. 29) 1924.

52. Ring, G. O.: Orbital Cavernous Hemiangioma with Pulsating Exophthalmos, Am. J. Ophth. **7**:946 (Dec.) 1924.

53. Jones, A. C.: Orbital Hemangioma Treated with Radium, Northwest Med. **24**:11 (Jan.) 1925.

gioma. In Ring's case the tumor was accompanied by pulsating exophthalmos and was the result of extension of a vascular growth into the orbit from the face, which was first noticed there when the patient was 2 years of age. The patient had had a ligation of the common carotid artery six years before. This failed to stop the progress of the intra-orbital extension. Jones' patient had a blue prominence, which first appeared in the left upper lid at the age of 2 weeks. Within six years it had progressed appreciably, and was accompanied with moderate exophthalmos, vertical displacement of the eyeball and diplopia; there was no bruit, and it did not change in size with any change in the position of the patient's head.

Plasmoma, or tumor of the extramedullary plasma cells, has been reported. Ewing [46] stated that such tumors are commonly classed as

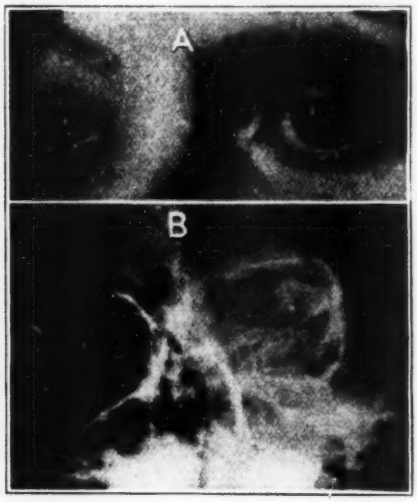

Fig. 20.—*A*, photograph, and *B*, roentgenogram, showing adamantinoma of the orbit (O'Brien).

lymphosarcomas but, "being as a rule, benign processes with very indistinct neoplastic properties, it is highly important that they should be separated from the malignant lymphosarcomas. They may recur after extirpation and become associated with a chronic cachexia." This confusion in diagnosis was illustrated in the case of plasmoma of the orbit described by Przybylska.[54] The patient's first operation had been done in a small continental city, and the examination of the tissue removed at that time resulted in a diagnosis of sarcoma. Secondary operation showed that the tumor had invaded the entire orbit, the maxillary antrums and the ethmoid cells, and exenteration of the orbit was necessary. The patient died after eighteen months, with signs of general cachexia.

54. Przybylska, J.: Plasmome de l'orbite, Ann. d'ocul. **161**:198, 1924.

Endothelioma is more commonly known by Cushing's preferred term, meningioma. Ewing [46] stated: "These tumors while not encapsulated show no great invasion capacity, and do not metastasize." On the other hand, certain cases have been reported in which either extensions or metastases in the neighborhood of the original tumor appeared. The roentgenogram in my case is shown in figure 21. In cases of this tumor the diagnosis is not definitely certain until after operation. The adult age of the patient, the slowly developing exophthalmos, the absence of pain and of tenderness, the negative findings in the fundus, the absence of any history of trauma and the extensive roentgenologic findings are necessary factors in making a preoperative diagnosis in any case. Cohen and Scarff [55] reported a case of a similar condition in which surgical intervention was attempted, but without complete success. The microscopic examination was reported to show fibroblastic tumor tissue, appearing as whorls about the blood vessels, with psammoma bodies present and with clusters of endothelial cells apparently

Fig. 21.—Roentgenogram showing meningioma of the left orbit of a patient with exophthalmos.

normal and, in general, on the surface of the fibrous tissue. Owing to the orbital invasion in this condition, surgical intervention is not satisfactory, except that which would be extensive and disfiguring and, in addition, ineffective as regards complete removal of the neoplasm.

Other cases of endothelioma occurring in the retrobulbar space have been reported, but these tumors did not show the characteristic type of tissue. The 2 cases reported by Williamson-Noble [56] demonstrated this. Both his cases were in children. In the first case the tumor seemed to appear as the result of postoperative trauma in a case of squint, and microscopically (to this author) seemed to be a plasmoma rather than a meningioma. The growth invested the optic nerve closely and seemed to arise from the arachnoid about the nerve. The tumor in the second

55. Cohen, M., and Scarff, J. E.: Unilateral Exophthalmos Produced by Meningioma of Middle Cranial Fossa, Arch. Ophth. **13**:771 (May) 1935.

56. Williamson-Noble, F. A.: Endothelioma of Orbit, Brit. J. Ophth. **7**:222 (May) 1923.

case contained not only endothelial cells but also blood spaces, fibrous tissue, cartilage and bone. Williamson-Noble stated:

> It is not conceivable that these cells would form cartilage and bone. The tumor, therefore, was not a typical endothelioma. Assuming that some pluropotential cells were cut off during embryonal life, later to resume activity, the growth could be a teratoma of the orbit—though careful search failed to show evidence of any other structures.

Rhabdomyoma has been reported as the cause of unilateral proptosis. This tumor originates in preexisting striated muscle, though it may occur in heterologous tissue. The tumor is rare and occurs usually in the tongue, heart muscle ("as the result of congenitally misplaced embryonic striated muscle"—Ewing) and skeletal muscle. It rarely metastasizes. Redslob [57] reported on the 3 cases described in the literature and included a fourth. All of them occurred in children between 2 to 5 years of age, and caused irreducible exophthalmos. In his case, in which there was a tumor on the external rectus muscle, the growth recurred. Microscopic examination of the second growth showed the tissue cells of typical round cell sarcoma, quite unlike the picture seen in the first mass removed. Redslob stated: "There can be no doubt that this second tumor is a recurrence, since the primary tumor showed zones of transition in which the morphologic degeneration of the tumoral rhabdocytes could already be plainly traced."

Tumors of neural or glial tissue, which may be extraneural as well as intraneural, and extra-ocular as well as intra-ocular, are diagnosed according to the type of the predominant cell. The work of Bailey, of Cushing, of Penfield and of others, has resulted in a differentiation of thirteen different types of glioma, depending on the resemblance of the cells to the embryonal cells at various ages; thus, medulloblasts, spongioblasts and neuroblasts are observed. Through stages of further differentiation the medulloblasts would produce oligodendroglioma; the spongioblasts, astrocytoma, and the neuroblasts, neuroma. Neuroblastoma shows, histologically, few, if any, glia fibers and is made up of cells resembling the primary neuro-ectoderm. It usually affects the adrenal glands in children and metastasizes frequently. Figure 22 *A* and *B*, from Lowenburg's pediatric service at the Mount Sinai Hospital of Philadelphia, shows the typical appearance in a case of this condition. The picture shown in *A* was taken three months before that shown in *B*, the latter having been taken a few days before the death of the child. *B* shows the huge extension at the midline of the frontal bone, which grew much more rapidly than did the metastatic growth in the retrobulbar space. Figure 23 shows a neuroblastoma reported by

57. Redslob, E.: Rhabdomyome de l'orbite à évolution atypique, Ann. d'ocul. **161**:721, 1924.

O'Brien, which was primary within the orbit and which occurred in an older patient.

Neuroma is essentially a benign glioma and is composed principally of both medullated and nonmedullated fibers, though a careful search may show some cells. It has been reported frequently as adherent to the optic nerve and can be diagnosed only at operation. The growth is very slow and is not accompanied by any characteristic symptoms. In Stieren's [58] case of neuroma of the orbit, the course and the observations

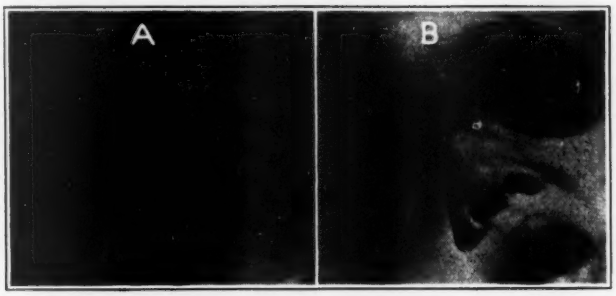

Fig. 22.—Appearance of the patient in Lowenburg's case of neuroblastoma (*A*) at the time of the earliest exophthalmos and (*B*) shortly before death. The metastatic growth in the forehead can be seen.

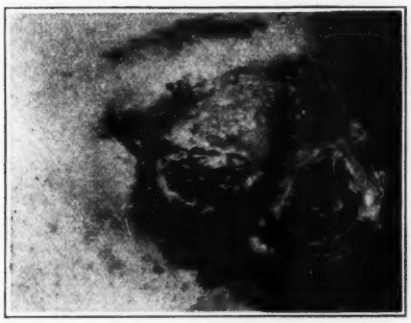

Fig. 23.—Appearance of the patient in O'Brien's case of neuroblastoma.

at microscopic examination were not quite typical of this condition. The patient was 28 years of age when the exophthalmos began to develop. It progressed slowly. Progressive hyperopia developed in the proptosed eye; few, if any, pathologic changes appeared in the fundus, and a roentgenogram showed a faint shadow in the retrobulbar space. Removal was uneventful and not difficult, and microscopic examination confirmed

58. Stieren, E.: Neurofibroma of the Orbit, Am. J. Ophth. **6**:176 (March) 1923.

the diagnosis of a neural tumor. In Benedict's [59] case the condition was more typical, and the case was interesting in that this author was able to follow the patient, a 7 year old child, for many years after surgical intervention. In this patient exophthalmos of eight months' standing had advanced rapidly within a month, and at the time of operation there was unilateral exophthalmos of 8 mm. At the removal of the tumor, through a superolateral periorbital incision (without resection of the orbital wall), it was found to lie within the muscle cone, was 1 cm. in length, and at the bulbar attachment of the optic nerve, where the tumor arose, it was no thicker than the optic nerve. Figure 24 *A*, *B* and *C* illustrates this case.

Spongioblastoma polare is a different glioma, which occurs, as a rule, in the optic nerve, the optic chiasm or the optic tract. It consists principally of either bipolar or unipolar spongioblasts. In Kiehle's [60] recently reported case of this condition, the growth was typical of this type of

Fig. 24.—Appearance of Benedict's patient with glioma of the optic nerve (*A*) before removal of the growth, (*B*) after removal and (*C*) ten years later.

tumor. This tumor occurs in children or in very young adults and is accompanied with slowly developing exophthalmos, which at some time begins to increase suddenly. The patient shows optic neuritis, usually of the retrobulbar type; retinal hemorrhages are common, and blindness usually occurs at an early period in the progress of the disease. The certain diagnosis of the type of tissue present must be made microscopically.

Neuro-epithelioma is rare in the brain and in the spinal cord but is a common lesion in the retina. It consists of primitive spongioblasts which tend to form many rosettes. Retinoblastoma shows a lesser differentiation of the cells and is more malignant, and it is considered that the rosettes are made up of primitive rods and cones. Exophthalmos resulting from these tumors would indicate extension of the tumor from

59. Benedict, W. L.: Removal of Orbital Tumors, Surg., Gynec. & Obst. **58**:383 (Feb. 15) 1934.

60. Kiehle, F. A.: Tumor of the Optic Nerve, Arch. Ophth. **15**:686 (April) 1936.

the globe through the scleral cribriform plate into the orbit. Surgical intervention or, at least, radiotherapy should have been carried out in cases of these tumors long before this complication has occurred.

The syndrome of tumor of the sphenoid ridge, described by Groff and Alpers,[61] is not uncommon. It illustrates a form of meningioma of the greater wing of the sphenoid bone, intracranial in origin, and demanding extensive neural surgical intervention because of its certain progress. The outstanding signs of the syndrome, as outlined by Groff[61a] in his report of cases, are as follows: primary atrophy of the optic nerve; defects in the visual field, which usually take the form of complete homonymous hemianopia (though the defect may be quadrantic); paralysis of the third nerve; unilateral impairment of the olfactory nerve, and unilateral exophthalmos. Additional symptoms, such as monoplegia, impairment of memory and disturbances of the pituitary body, are observed. Figure 25 shows the characteristic roentgen findings in this condition.

Fig. 25.—Roentgen findings in a case of tumor of the sphenoid ridge (Groff).

Sarcoma, mixed cell tumor and carcinoma have all been responsible for unilateral exophthalmos. These conditions are of grave prognostic import, however. Occasionally the patient is free from metastasis for many years, and other patients die early with involvement of the mediastinum and liver. Figure 26 shows the eye of a young colored man with primary retrobulbar sarcoma. Complete orbital exenteration was done, and the patient is still alive eighteen years later. Figure 27 shows the orbit, as it appears at present, of a patient with intra-ocular sarcoma with secondary orbital extension. This photograph was taken three years after a recurrence. The results of radium therapy are evident in the tissues. Figure 28 shows the appearance of a child, a patient of O'Brien's, with primary sarcoma. This case illustrates well the fact that sarcoma is more common in younger patients. Carcinoma occurs

61. (*a*) Groff, R. A.: Syndrome of Meningeal Fibroblastoma Arising from Lesser Wing of Sphenoid Bone, Arch. Ophth. **15**:163 (Feb.) 1936. (*b*) Alpers, B. J., and Groff, R. A.: Parasellar Tumors: Meningeal Fibroblastomas Arising from Sphenoid Ridge, Arch. Neurol. & Psychiat. **31**:713 (April) 1934.

more commonly in those of later years. In Howland's [62] case of mixed cell sarcoma in a girl 20 years of age, in which the tumor was removed by him from the orbital muscle cone by Krönlein resection, the condition was illustrative of that in such cases. The exophthalmos was of from four to six months' duration, there were no inflammatory reactions, the fundus showed no pathologic changes, and there was no definite paralysis of oculomotor nerves, but a solid mass, which was somewhat movable, could be palpated deep in the orbit. At operation it was found to be encapsulated and was removed rather readily. Further radiotherapy was carried out, after microscopic examination and

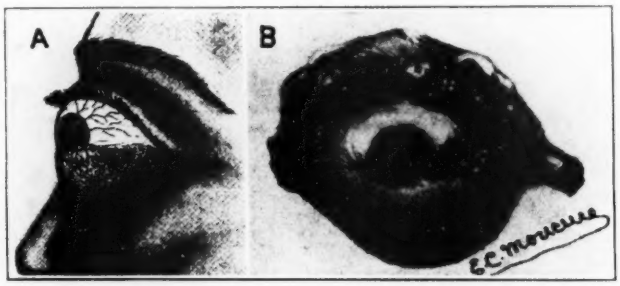

Fig. 26.—*A*, primary retrobulbar sarcoma; *B*, the eyeball after exenteration.

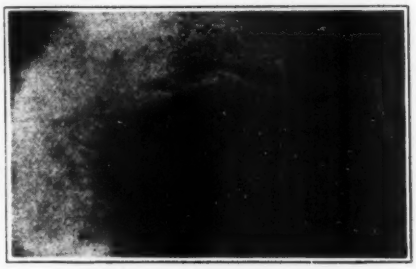

Fig. 27.—The socket of a patient with intra-ocular primary sarcoma three years after surgical intervention for removal of a recurrent orbital growth and subsequent radium therapy.

the receipt of the pathologist's report. The serious factor in cases of this condition is the early necessity for a diagnosis in the course of the condition: It should be determined that the condition of the orbit calls for surgical intervention and that it must be explored for more certain diagnosis. Gumma of the orbit might simulate this tumor, but other signs and symptoms are present in cases of the latter condition which are not seen in cases of a sarcomatous neoplasm.

62. Howland, A.: Personal communication to the author, from the Wills Hospital, October 1936.

Both carcinoma and sarcoma have extended from the antrum, from the ethmoid sinuses and from the septum into the orbit. The complications are not uncommon and are often terminal. Psammoma has been reported as extending from the ethmoid sinuses; chondroma has extended into the orbit from the septum, and myxoma has extended into the orbit from the frontal sinus. A malignant growth extending from the nasal accessory sinuses is, fortunately, not as common as one might expect, considering the high percentage of persons who suffer from chronic and recurrent sinusitis.

A metastatic malignant growth secondary to tumor of the stomach, the adrenal glands, the kidney, or the long bones of the body has been reported frequently as the cause of unilateral exophthalmos. This growth, naturally, is recognized as secondary, though the fact that it is so does not in any way change the seriousness of the condition. In Lowenburg's [63] case of neuroblastoma of the adrenal gland and in Van Duyse

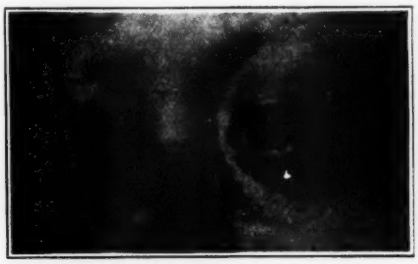

Fig. 28.—Retrobulbar sarcoma in a child (O'Brien).

and Marbaix's [64] case of hypernephroma, the condition was typical of the rare forms. Retrobulbar carcinoma has been seen secondary to adenocarcinoma of the stomach, and retrobulbar sarcoma has been seen resulting from osteogenic sarcoma of the tibia, and these cases are not exceptions.

DIFFERENTIAL DIAGNOSIS

Trauma, inflammatory conditions and neoplasm are the three conditions which present the greatest problems in arriving at a correct diagnosis in any case of unilateral exophthalmos under consideration. The history is of tremendous importance, especially in the consideration of some of the inflammatory possibilities. The rate of progress of the exophthalmos and the age of the patient at its onset will be of assistance in other cases. Pain is a characteristic symptom in some of the cases

63. Lowenburg, H.: Personal communication to the author, from the Mount Sinai Hospital, Philadelphia, 1936.

64. Van Duyse, D., and Marbaix: Métastase eithmoïdo-orbitaire d'un hypernéphrome latent, Arch. d'opht. **39**:396 (July) 1922.

in which no tumor is present., Swelling of the lids and chemosis of the conjunctiva are characteristic of the inflammatory conditions. With an inflammatory condition the exophthalmos not uncommonly becomes bilateral; with tumor it rarely becomes so. The roentgen examination may be of great assistance in the diagnosis of tumor within the orbit, but this is seldom so in inflammatory exophthalmos save in cases in which the all-important relationship with the nasal accessory sinuses is significant. The possibility of hydatid cyst is to be considered in those cases in which the patient is from a country or a location where such a condition is endemic. In general, neoplasms occur in the earlier years of life, inflammatory conditions in the years from middle to later life, and metastatic retrobulbar masses still later in the life of the patient. In cases of exophthalmos due to conditions of the lymph and of the blood-forming system, the patient will have the other, general symptoms of these conditions. Thyroid conditions demand careful consideration; in Howland's case (which was cited), for instance, thyroid disease was considered to have been present early in the course of the development of the exophthalmos.

In general, one should and must call on allied brother specialists for assistance to obtain a correct diagnosis in many of these cases of unilateral exophthalmos. The treatment, depending on the different possible etiologic factors, is so varying that errors in diagnosis must be reduced to a minimum.

News and Notes

GENERAL NEWS

Leslie Dana Gold Medal.—Mrs. Winifred Hathaway, of New York, associate director of the National Society for the Prevention of Blindness, was given the Leslie Dana Gold Medal, awarded annually for outstanding achievements in the prevention of blindness and the conservation of vision. Mrs. Hathaway was selected for this honor by the St. Louis Society for the Blind, through which the medal is offered by Mr. Leslie Dana, of St. Louis.

The presentation of this medal took place at a luncheon meeting of the Association for Research in Ophthalmology, in Atlantic City, N. J., Tuesday, June 8, during the convention of the American Medical Association. Dr. Park Lewis, of Buffalo, the recipient of the medal in 1928, made the presentation address.

Mrs. Hathaway, the second woman to be accorded this honor, has achieved an international reputation through her many years of service in the campaign to save eyesight. Largely through her personal efforts, there are now 525 sight-saving classes throughout the United States, where children with seriously defective vision receive a normal education. She has addressed audiences in practically every section of this country, has visited Hawaii, England and other European countries, and has given courses for the training of teachers and supervisors of sight-saving classes at numerous universities and normal schools.

Mrs. Hathaway is a member of the Advisory Board of the International Council for Exceptional Children and of the Committee on Industrial and School Lighting of the Illuminating Engineering Society and is associated with several other professional organizations. She is a graduate of Radcliffe College and received her degree of Master of Arts from New York University.

Presentation of the Nettleship Medal.—At the Annual Congress of the Ophthalmological Society of the United Kingdom, held in London from April 29 to May 2, the Nettleship Medal was presented to Mr. H. B. Stallard, of the ophthalmic department of St. Bartholomew's Hospital, for his work on the treatment of glioma of the retina by radium emanations.

UNIVERSITY NEWS

Summer Course in Ophthalmology at the University of Rochester.—The department of ophthalmology of the University of Rochester School of Medicine and Dentistry will conduct the eighth annual summer graduate course of lectures and demonstrations in ophthalmology, beginning Monday, July 26, and ending Friday evening, July 30, 1937.

The course will cover ophthalmic surgery, ophthalmoscopy and medical ophthalmology, perimetry and ophthalmic neurology, slit lamp microscopy, ophthalmic myology, pathology, retinoscopy and refraction. The tuition fee for the course is $40. Checks should be drawn to the order of Dr. John F. Gipner, the Strong Memorial Hospital, Rochester, N. Y.

SOCIETY NEWS

International Committee for the Protection of Eyesight and for the Prevention of Blindness.—During the five years of its existence the International Committee for the Protection of Eyesight and for the Prevention of Blindness has established branch committees in almost all parts of the world. The organization has dealt with the prevention of industrial accidents, with trachoma and with the erection of schools for children with reduced or impaired vision. The latest report of the committee reveals that there are about 6,000,000 blind persons in the world. The chief causes of blindness are injuries, glaucoma, heredity and infection. The committee makes provisions for the education of the unfortunates so that they may work and supports them in their activities.

National Society for the Prevention of Blindness.—The National Society for the Prevention of Blindness has issued its annual warning to parents regarding the risk to children's eyesight through the careless use of fireworks on the Fourth of July. A study of accidents due to fireworks, made two years ago, disclosed a total of 6,940 injuries which were serious. In the American schools for the blind there are now nearly 500 children who lost their sight as a result of accidents, chiefly through the use of fireworks and air rifles.

Correspondence

"TREATMENT OF RETINAL GLIOMAS BY THE FRACTIONATED OR DIVIDED DOSE PRINCIPLE OF ROENTGEN RADIATION"

To the Editor:—In a paper entitled "Treatment of Retinal Gliomas by the Fractionated or Divided Dose Principle of Roentgen Radiation," publihsed in the November 1936 issue (ARCH. OPHTH. **16:** 734), my collaborator and I stated:

> Verhoeff's patient . . . received a "suberythema dose" of lightly filtered roentgen radiation to the eye once a week for three weeks.

This statement is not in accord with Verhoeff's report, which reads:

> Dr. Liebman gave the first treatment on the same day, a sub-erythema dose through a 5 mm. aluminum filter. After this, similar treatment was given once a week for three weeks, and on June 6th, June 27th, August 1st, November 1st, 1918, and on January 17th, 1919.

We admit the error in quotation and gladly take this opportunity of correcting it.

A. B. REESE, M.D., New York.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Anatomy and Embryology

CONNECTIONS OF THE RODS AND CONES AT THE LEVEL OF THE EXTERNAL PLEXIFORM LAYER. F. FERNÁNDEZ BALBUENA, Arch. de oftal. hispano-am. **36:** 337 (July) 1936.

After reference to the exceptional interest attached to the external plexiform layer as the site of the connections between the first and second retinal neurons, to the investigations hitherto made with modern methods of staining and to certain prevailing errors due to artefacts, Balbuena presents a remarkable study illustrated with a number of beautiful photomicrographs of sections of the external plexiform layer in the owl, rabbit, monkey and man; most of which were stained according to the method of Golgi. The article is posthumous; Balbuena died on March 4, 1936.

He maintains that the terminal "rod" spherules are mostly in contact with the bases of the cones, which they surround; he describes the topography, with its variations, of the "cone" bases, which are situated external to the external plexiform layer, with the connections of their divergent and convergent fibrils. He also describes "sinaxic bipolar cells," a new variety of horizontal cells, which receive impulses from the rods and cones and are connected with the external endings of Cajal's "rod" bipolars, the ascending fibers of the so-called horizontal cells. These cells he considers as forming an intermediate neuron (the proper second neuron), collecting luminous impulses from the cones and rods, whereas Cajal's "cone" bipolars receive excitations from only the foveal cones. He finally describes the following sublayers of the external plexiform layer: (1) a dense plexus of fibrils uniting the bases of the cones; (2) a superficial dendritic plexus, described by Cajal, formed by fibrils from the internal horizontal elements; (3) Cajal's internal dendritic plexus with an interlacing of large branches from the large horizontal cells; (4) horizontal ramifications of the cone bipolars, a dense plexus of centrifugal fibers, described by Cajal, and the terminal branches of the axis-cylinders of the horizontal cells. In the midst of the last two layers he observed the ascending branches of Cajal's rod bipolars and conical dilatations of the sinaxic bipolars, the bases of which appear above the external plexiform layer.

C. E. FINLAY.

Bacteriology and Serology

ANTIGENIC PROPERTIES OF THE CORNEAL PROTEIN. S. RINALDI, Ann. di ottal. e clin. ocul. **64:** 691 (Oct.) 1936.

Rinaldi describes the use of intradermal tests made with a corneal emulsion on 200 patients with various types of keratitis and on 150 normal persons. The material was prepared by using one cornea to 10 cc. of physiologic solution of sodium chloride, 0.1 cc. of which was used for the intradermal test. Only 3 patients with keratitis, including

2 with serpiginous ulcer and 1 with phlyctenulosis, and 2 normal subjects, gave positive intradermal reactions. This is added evidence that the corneal protein possesses few or no antigenic properties and seems to dispose effectively of various theories, such as that of Elschnig, which attempt to explain interstitial keratitis and other conditions on the basis of autosensitization to the corneal proteins. A bibliography is included.

S. R. GIFFORD.

Biochemistry

RECENT OBSERVATIONS ON THE BIOCHEMISTRY OF THE LENS. DOROTHY R. CAMPBELL, Brit. M. J. **2:** 1133 (Dec. 5) 1936.

This is a review of work which has been done on the biochemistry of the lens during the past three years. New methods for producing experimental cataract and their results are described under the following headings: (1) a disturbance of carbohydrate metabolism, (2) a deficiency of vitamins, (3) investigation of hereditary cataract in animals and (4) the administration of toxic substances.

In addition, general metabolic changes which may be associated with cataract have been investigated, and new substances in the lens have been identified.

This survey has been most carefully done and gives a valuable outline of present knowledge. The contents cannot easily be given in a review. Those interested will be well repaid by a study of the original article.

The author concludes as follows: "An excess of sugar or deficiency of vitamin, a disturbance of calcium metabolism, or loss of cystine from the lens, are all very likely factors in the causation of cataract, and even the effects of rare toxic substances have acquired an unexpected significance. Not only new facts, but those with which we are already familiar, are assuming a more orderly arrangement."

A. KNAPP.

THE MAGNESIUM CONTENT OF OCULAR TISSUES. R. WOLFF and A. BOURQUARD, Compt. rend. Soc. de biol. **124:** 319, 1937.

The glycolytic action of the retina is the highest in the body, and magnesium is the coferment required for glycolysis. The distribution of magnesium in the tissues may possibly be correlated with functional activity. The magnesium content of the retina is high (90 mg. per hundred grams of dry tissue) but inferior to that of muscle. The pigment layer contains somewhat less magnesium than the retina, and the optic nerve, only half as much.

J. E. LEBENSOHN.

Comparative Ophthalmology

RETINAL LOCALIZATION IN RELATION TO DORSOVENTRAL POLARITY OF BLACK COLORING IN AXOLOTL. V. VILTER, Compt. rend. Soc. de biol. **124:** 47, 1936.

The axolotl (larval salamander) exhibits a chromatic adaptation to its background in which the dorsal coloration regularly fades out ven-

trally. A blinded animal becomes progressively darker but maintains the normal polarity. However, after 180 degree torsion of the seeing eyeballs was performed surgically, the animal's color became uniform the next day, and later the usual polarity was reversed. With only one eye turned, a contralateral change in pigmentation ensued. Hence the visual field appears related to the neuro-endocrine regulation of the melanocytes.

J. E. LEBENSOHN.

THE FOVEAL VISION OF FISH. M. F. CANELLA, Compt. rend. Soc. de biol. **124:** 405, 1937.

Observations on fresh water fish blinded in one eye confirm the conclusion indicated by the author's similar investigation on mammals: Blinding of one eye simply reduces the total visual field without appreciably affecting third-dimensional perception.

J. E. LEBENSOHN.

Cornea and Sclera

A METHOD FOR MAKING CASTS OF THE HUMAN CORNEA. C. L. STEVENS, Am. J. Ophth. **19:** 593 (July) 1936.

Stevens describes a method of making casts of the cornea with negocoll. This is melted or dissolved in water and allowed to cool at 40 C. The eye is anesthetized; the patient is instructed to look at a mark on the ceiling, and the negocoll is applied to the cornea by means of an aluminum container applied to the globe. The inner canthus should be marked on the container tube. The negocoll sets in about five minutes and is then removed and immersed in cool water and properly labeled. From this a cast is made of French's "Regular" dental plaster, the identifying mark at the inner canthus being preserved.

W. S. REESE.

INFLUENCE OF VITAMIN A ON THE REGENERATION OF CORNEAL EPITHELIUM. E. HEINSIUS, Arch. f. Ophth. **136:** 103 (Sept.) 1936.

Clinical observation has shown that vitamin A applied locally has a favorable influence on the healing of wounds. Heinsius produced complete corneal abrasions on both eyes of the rabbit and watched the regeneration of the epithelium under the influence of cod liver oil or pure vitamin A, which was instilled regularly into the conjunctival sac of one eye while the other eye received only paraffin oil. The defects healed more quickly in the eyes which were treated with preparations of vitamin A. The vitamin D contained in cod liver oil had no effect on the regeneration of the epithelium.

P. C. KRONFELD.

HISTOLOGIC-ANATOMIC RESEARCH ON TRUE MEGALOCORNEA GLOBOSA. B. KAYSER, Klin. Monatsbl. f. Augenh. **96:** 721 (June) 1936.

Kayser concludes with this paper his series of publications of his research on megalocornea. The following definite information was gained from the histologic-anatomic examination of one eyeball:

1. Glaucoma played no rôle in the development of the megalocornea.

2. It is certain that one form of true, uncomplicated megalocornea exists, in which the changes are limited to the anterior segment of the

eyeball, especially to the shape of the cornea, with later changes of the chamber angle and ciliary body. No inflammatory or degenerative processes exist by which secondary enlargement of the cornea could be explained as a result of softening or extension.

3. True megalocornea must be strictly distinguished from "secondary megalocornea," which is the result of pathologic processes. True megalocornea is identical with Horner's megalocornea globosa.

4. No findings have been made which would cast a doubt on the view that megalocornea is a developmental anomaly.

5. Macrophthalmos and megalocornea are two different conditions; enlargement of the cornea is a symptom common to both.

K. L. Stoll.

Experimental Pathology

Production of the Shwartzman Phenomenon in the Cornea. G. Fabiani and A. Gauthier, Compt. rend. Soc. de biol. **124:** 51, 1937.

The hemorrhagic allergic phenomenon of Shwartzman occurs readily in the conjunctiva and iris, though not in the cornea. This immunity, however, is solely based on the normal corneal avascularity. An infected corneal ulcer in a rabbit terminated in a highly vascularized leukoma. When a bacterial filtrate was injected, first in the corneal tissue and the following day intravenously, a hemorrhagic extravasation in the cornea appeared.

J. E. Lebensohn.

The Nature of Disk-Shaped and Ring-Shaped Corneal Opacities. Y. Sugita, Arch. f. Ophth. **136:** 52 (Sept.) 1936.

In Sugita's fundamental experiment a deep but nonperforating corneal wound about 1.5 mm. in diameter was produced with the galvanic cautery and concentrated sulfuric acid applied to its floor. The result was the development of a dense disk-shaped corneal opacity which, according to the author, was analogous to the periodic precipitation in the form of concentric rings which takes place in gelatin by the gradual diffusion toward each other of two types of ions previously added to different portions of the gelatin (Liesegang's rings). The clinical and the pathologic picture of this experimental corneal opacity are the same as those of disciform keratitis in man. In the latter case micro-organisms apparently are capable of eliciting biochemical processes similar to those in Liesegang's experiment. The same consideration may apply to other types of keratitis in which disk or ring-shaped opacities occur.

P. C. Kronfeld.

Effect of Nephrotoxin on the Eye. S. Yonechi, Arch. f. Ophth. **136:** 312 (Dec.) 1936.

Zur Nedden was the first to report retinal changes after injection of a specific nephrotoxin into the carotid artery. Since then, in 1908, Japanese investigators under the direction of Mita (the University of Tokio) found that retinal and renal proteins are closely related immunologically. Yonechi, a pupil of Koyanagi, was chiefly interested in the

effect of nephrotoxins on the pigment epithelium. By repeated intraperitoneal or subcutaneous injection of an emulsion of rabbit kidneys into goats serums were obtained which, if injected into rabbits, produced, clinically and pathologically, diffuse glomerulonephritis (Masugi: *Beitr. z. path. Anat. u. z. allg. Path.* **92:** 429, 1934). The injections were made into the common carotid artery. Ligation of the artery after the injection was never necessary. The effect on the eye of the side given the injection appeared in the form of chemosis, exophthalmos and gray streaks and patches in the retina. Pathologically, small accumulations of coagulated protein were found in the retina, with abnormal secretory activity of the pigment epithelium and secondary degenerative changes in the latter and in the adjoining retinal layers. "The nephrotoxin acts chiefly on the pigment epithelium." P. C. KRONFELD.

General Diseases

DIABETES AND THE EYE. A. E. GOLDFEDER and M. A. KOPELOVITS, Sovet. vestnik oftal. **9:** 798, 1937.

In the Central Ukranian Institute of Endocrinology a study was made of 500 diabetic patients.

Lowered tonus of the eyeball was found in 53 per cent of the patients. In 70.6 per cent of the young patients disturbance of accommodation was observed. Refractive errors were of myopic and of hypermetropic character. Cataracts were found in 7.3 per cent. In the untreated diabetic persons the cataracts ripened very fast, while in the treated ones the ripening of the cataracts usually took many months. There were always vacuoles beneath the anterior capsule, also *Wasserspalten* (water slits). Extraction of cataract presented no difficulties provided that the patient's blood and urine were rendered free from sugar and acetone.

Diabetic retinitis (hemorrhagic type) was observed only in 1.8 per cent, mostly in elderly patients. Insulin therapy caused increase of hemorrhages in a few patients, so the authors believe that it should be given cautiously.

Since xanthelasma was found in 1.4 per cent, the authors think that it may be connected with disturbance of carbohydrate metabolism. In 35 per cent there was weakness of ocular muscles or absence of convergence; only one patient suffered from paresis of the sixth nerve. In 14 per cent there was anisocoria, and in 6.6 per cent Stellwag's and Graefe's signs were present. O. SITCHEVSKA.

ROENTGENOTHERAPY IN LUPUS OF THE CONJUNCTIVA AND CORNEA. F. B. GOLDBERG, Sovet. vestnik oftal. **9:**893, 1937.

A girl aged 19 suffered from lupus of the face six years ago. The condition improved under treatment with roentgen rays and tuberculin. Four years ago the left eye became inflamed, and the inflammation persisted despite routine therapy. Examination revealed thickening of the conjunctiva of the lids and of the fornices with solitary small grayish nodules. The bulbar conjunctiva presented more advanced changes. It was thickened and reddish gray, with an abundance of grayish nodules; it was covered with a granulation tissue that extended to the

periphery of the cornea. The granulation tissue was heaviest in the upper sector, resembling pannus crassus, and showed a number of gray nodules. Histopathologic examination showed that the nodules were tuberculous granulomas consisting of epithelioid and giant cells with some fibrous tissue.

Since surgical intervention was impossible because of the extensiveness of the process, roentgenotherapy was decided on; ⅛ of 1 H.E.D. (unit skin dose) was administered every seven to ten days. The treatments (seven) caused marked aggravation of the symptoms, and vision was reduced from 0.2 to 0.06. This persisted for three months, with a further reduction of vision to perception only of light. A larger dose of roentgen rays (¼ of 1 H.E.D.) was given, and after four treatments the symptoms began to subside. In a few months fine scars formed in the conjunctiva, the pannus absorbed, and vision improved, but only to 0.05 because of diffuse central corneal opacities. Thus a larger dose of roentgen rays proved to be the means of curing this rare lupus, while the initial smaller dose caused aggravation of the process with irreparable loss of vision.

O. SITCHEVSKA.

Glaucoma

CLINICAL MEASUREMENT OF THE OCULAR TENSION. P. BAILLIART, Ann. d'ocul. **173:** 945 (Dec.) 1936.

Following a recent communication read at a meeting of the Ophthalmologic Society of Paris, in which Mérigot of Treigny justly defended the operative treatment of glaucoma, the question has naturally been raised again as to the most opportune time for operation. Is this when hypertension commences? What is the highest limit of physiologic tension that is known?

Morax, an authority whom one always likes to quote, wrote in 1921: "One considers as normal, that is, having no harmful consequences, a tension between 15 and 28 mm. of mercury. In fact, since I have examined the globe with the Schiötz tonometer I have never met with glaucomatous symptoms in eyes having a tension less than 30 and have never considered as pathologic any aggravation in the tension of glaucomatous eyes up to 28. Does this signify that the physiologic ocular tension lies between 18 and 28 mm. of mercury?"

Bailliart gives in detail his experiments with the tonometer on patients in his clinic. He divides the cases into three groups. In the first group the ocular tension remained as it was when first taken, the needle moving between 25 and 23. In the second group the needle continued to move but tended to move downward, oscillating between 24 and 22, 23 and 21, etc. In the third group the reverse occurred; the needle continued to move but moved upward, oscillating between 34 and 30, 36 and 32, etc.

Too much importance must not be placed on the tonometer. Although it is an excellent instrument, its value is relative. To establish the diagnosis, prognosis and treatment, one must not depend on figures but search for symptoms, and to relieve symptoms the cause must be found.

S. H. MCKEE.

INTRA-OCULAR TENSION AFTER PARACENTESIS IN EYES WITH NORMAL TENSION, CHRONIC SIMPLE GLAUCOMA AND UVEITIS WITH HYPOTONY. O. BARATTA, Arch. di ottal. **43:** 211, 1936.

Ten eyes with cataract but normal tension, eight with chronic simple glaucoma and nine with anterior uveitis and hypotony were employed. In the eyes with normal tension a rise of tension amounting to from 3 to 5 mm. was found after three hours, which was replaced after one or two hours by slight hypotony, persisting as a rule for twenty hours. This was followed by a second slight rise of tension, persisting until from thirty-two to forty-five hours after the paracentesis. In the glaucomatous eyes a rise of tension of from 10 to 16 mm. above the original tension was observed after three hours. In five of the eight eyes this persisted until six hours after the paracentesis, after which a fairly rapid fall occurred to figures below the original tension, with a return to the original tension after forty-eight hours. In three eyes there was a gradual fall to the original tension, beginning after three hours and never going below that point. In six of the nine eyes with uveitis and hypotony, the tension reached only 1.5 mm. below the original tension after three hours, rising slowly to the original figure after from three to four days. In three of the nine eyes there was a slight increase of tension above the original figure, followed by prolonged hypotony like that seen in the other eyes with uveitis. In this group of eyes a disturbance of the mechanism for the formation of aqueous must be assumed, while in the normal and glaucomatous groups the behavior of tension was analogous to that of cerebrospinal fluid pressure after lumbar puncture or of arterial pressure after removal of blood.

S. R. GIFFORD.

Injuries

INJURIES OF THE EYES CAUSED BY SMALL SHOT. P. ILLÉS, Szemészet **70:** 211, 1935.

Within the field of bullet wounds of the eye, those made by small shot, especially while the patient was hunting, occur most frequently. The entering course of small shot is always sagittal. In most cases only a single shot has entered, but the injury may have such serious consequences as retinal hemorrhage and detachment of the retina. Often the shot remains in the eye. Double perforation of the eyeball may occur, the shot remaining in the orbit, where it may cause injury or atrophy of the optic nerve.

The clinical notes for three of the author's cases are given in full. In the first case there was a superficial injury of the cornea, which healed readily, with consequent full acuity of vision. In the second case there was a hemorrhage into the vitreous, and an attack of glaucoma occurred. In this case healing took place within four days, and acuity of vision was normal. In the third case the shot lodged in the sclerotic wall, leaving no serious functional disturbance. Six months later the eye showed a permanent scotoma but no other damage.

The prognosis in cases of wounds made by small shot and double perforation may be favorable, but the injury may lead to serious con-

sequences, causing shrinking of the eyeball following iridocyclitis. It should be a rule that small shot should not be removed unless there is an inflammatory reaction.

N. BLATT.

Lens

EMBRYONAL, FETAL, ZONULAR AND CENTRAL CATARACT. G. FAVALORO, Ann. di ottal. e clin. ocul. **64:** 721 (Nov.) 1936.

The older literature concerning congenital central (nuclear) cataract is reviewed, as well as that based on modern findings with the slit lamp. A case of bilateral embryonal nuclear cataract is described, the opacity being from 3 to 4 mm. in diameter and corresponding to the size of the lens in the fifth fetal month. In a second case each lens showed three zones of opacity: a central opacity, the most dense, corresponding to the embryonal nucleus; a more peripheral grayish zone with a sharply outlined border, corresponding to the fetal nucleus, and six spokes of opacity radiating from this zone to the periphery of the lens. Signs of defective development and of rickets were present. In a third case only the fetal nucleus was involved, but three layers could be distinguished. The most central was very dense, triangular and corresponded in size only to the region of the anterior Y suture. The second and third were less dense and of a powdery appearance, corresponding to the middle and late periods of fetal life. In a fourth case one eye presented a total cataract, but with a denser central opacity corresponding to the embryonal nucleus, while in the other eye only the fetal nucleus was involved. From these observations and others in the literature Favaloro would distinguish the zonular form of nuclear cataract in which all the zones of opacity are confined to the fetal nucleus from the more usual zonular, or perinuclear, cataract. The greater density of the most central portion in his nuclear cataract indicates an origin of the opacity very early in fetal life and in the most central part of the lens, in contradistinction from zonular perinuclear cataract, which begins in postnatal life or late in fetal life. It is also possible to distinguish, according to the size of the opacity, between embryonal cataract, which develops during the first four months of intra-uterine life, and fetal cataract, which develops later in fetal life. If the process of opacification continues until the end of fetal life, a total cataract will result.

S. R. GIFFORD.

REPAIR OF CAPSULE WOUNDS BY THE SURVIVING LENS. A. BAKKER, Arch. f. Ophth. **136:** 333 (Dec.) 1936.

Injury of the anterior lens capsule in man causes, as a rule, a progressive cataract or complete absorption of the lens, while in rabbits and in a few other animals the wound is closed by formation of fibroblast-like cells, which are overlaid by regenerated lens capsule. The process remains confined to the site of injury, and the transparency of the bulk of the lens is not disturbed. The question of the origin of the fibroblast-like cells has not been solved. Schirmer believed they were derivatives of the lens epithelium. Bakker studied these processes on the surviving lens (*Arch. f. Ophth.* **135:** 581, 1936; **136:** 166, 1936) and found that they were essentially the same as in vivo. Since the

only type of cells present in the surviving lens are cells of the capsular epithelium the ectodermal origin of the cells which repair capsular wounds in rabbits is now certain.

P. C. KRONFELD.

Lids

ETIOLOGY AND PATHOGENESIS OF CHALAZION. G. SOLIGNAC, Ann. d'ocul. **174:** 108 (Feb.) 1937.

Even though chalazion is known as a benign disease and therefore of secondary importance from the clinical point of view, it has been the subject of numerous researches. Its histologic structure particularly has been studied. Even yet, however, there is considerable difference of opinion as to how certain characteristics of the chalazion should be interpreted. Bacteriologic investigation has not given satisfactory results, and the pathogenesis still remains obscure.

Solignac goes into considerable historical detail from 1858, when Sichel attributed the condition to a microbic origin, to 1932, when Bailey gave a general review of the anatomy, pathology and surgery. The histologic examination is given in detail, with two illustrations, also the results of experimental inoculations and bacteriologic examinations.

He concludes from this histologic study that he is in accord with Shall in the opinion that the chalazion is the result of a chronic inflammatory process with phagocytosis in which the bacterial infection does not play a primary rôle but is secondary, and that the condition is relatively rare. The term *granulome stéatophagique* employed by Levaditi seems justified. A bibliography is given.

S. H. MCKEE.

Methods of Examination

THE IMPROVED FIVE POINT VISUAL ADAPTOMETER FOR MEASURING SENSITIVENESS TO LIGHT. A. BIRCH-HIRSCHFELD, Klin. Monatsbl. f. Augenh. **97:** 433 (Oct.) 1936.

The efficiency of the five point adaptometer devised by Birch-Hirschfeld for measuring the sensitiveness to light was shown during the war. It was used also for scientific research, for example, by Ira O. Park in his studies on vitamin deficiency. This apparatus has been improved by the author in many respects. The chief principle remains unchanged: Five points of light are arranged in such a way that two points placed vertically on the left side are brighter and two on the right side are darker. This arrangement facilitates accurate observation of the fifth point, located in the center. In the improved apparatus the gray graduated wedge is replaced by a series of graduated gray glasses. They are fitted on a disk in a circle, so that by inserting them behind the five points the brighter points can be made to appear darker than the central point and the darker points brighter than the central point. A detailed description of the apparatus and the technic is given and illustrated by pictures and a table. Satisfactory results were obtained by Birch-Hirschfeld with this improved apparatus in examination of a large number of airmen at the University Eye Clinic of Königsberg, Germany.

K. L. STOLL.

Neurology

OCULAR SYMPTOMS OF SUPRASELLAR MENINGIOMAS. E. HARTMANN and L. GUILLAUMAT, Ann. d'ocul. **174:** 1 (Jan.) 1937.

In its development, suprasellar meningioma presses on the optic nerve and the chiasm and by so doing causes visual disturbance, which is one of the first clinical signs and one of the important elements in the prognosis. The condition is often confused with retrobulbar neuritis of toxic or infectious origin. Surgical intervention offers the only possible treatment and gives good results. Vision is improved, and, as meningioma is histologically benign, it does not become generalized, while a local recurrence, if it does take place, comes on slowly.

Cushing stated: "When the question 'what's wrong with you?' is put to adult patients who are referred to a neurosurgical clinic, the answer 'my sight is failing' is probably, in these latter days, far more often given than any other." Failure of central vision and contraction of the peripheral visual field should direct one to immediate examination of the fundus.

In this article a summary of the findings for twenty-one patients is given. The diagnosis was verified microscopically and histologically in all the cases. The article is illustrated with drawings and tables, and a bibliography is given.

S. H. MCKEE.

RELATIONS BETWEEN HEMIANOPIA AND OPTOKINETIC NYSTAGMUS. J. OHM, Arch. f. Ophth. **136:** 341 (Dec.) 1936.

In a large number of cases of hemianopia and with his very accurate method of nystagmography Ohm has studied optokinetic nystagmus. His study confirms his previously expressed opinion that a lesion conconfined to the visual pathway does not affect optokinetic nystagmus, and also, at least in principle, Cord's view that optokinetic nystagmus toward the blind side becomes disturbed if the efferent as well as the afferent visual radiation is affected. Ohm, however, has seen, and quotes others who have seen, exceptions to the latter rule.

P. C. KRONFELD.

TUMORS IN THE REGION OF THE HYPOPHYSIS. M. BARTELS, Klin. Monatsbl. f. Augenh. **97:** 185 (Aug.) 1936.

Bartels selected for his report seventeen cases of tumor in the region of the hypophysis, which he observed to show the importance of ophthalmoscopic and allied examinations of patients suffering from apparent anemia, "neurasthenia" and other seemingly constitutional diseases. Critical considerations are given for each case, and a résumé of the ocular and general disturbances found is offered. Each of these disturbances, including a number of instructive deviations from the usual pathologic aspects, is discussed critically in detail.

In concluding, Bartels states that his observations furnished only this definite general conclusion: A reliable prognosis could be made in no case, nor was it possible to foretell definitely whether an operation was indicated or not. Every case of this type should be referred for observation to some "central" or clearing house, a custom which

is being practiced by some groups of surgeons in Germany. Thus the best results would be obtained, and the question of surgical procedures might be considered carefully. Bartels points out a number of errors leading to wrong diagnoses, e. g., in cases in which a tumor is absent which was thought to be present. In this connection he mentions physiologically abnormal growth in males during the period of development in puberty which may resemble adiposogenital dystrophy. One of his cases belonged to this group; the patient presented a transient hormonal disturbance during puberty. Conditions of this kind may be based on familial heredity and appear during puberty in persons who remain perfectly normal afterward during their whole life. The absence of ocular symptoms in a suspected case at any time would not entirely exclude the presence of a tumor of the hypophysis, yet a wrong diagnosis would cause unnecessary excitement in the family.

K. L. Stoll.

Orbit, Eyeball and Accessory Sinuses

The Oculocardiac Reflex and Sugar Metabolism. G. Portoghese, Arch. di ottal. **43:** 181, 1936.

Literature on this reflex and also on the oculovasomotor reflex is reviewed. Both are produced by pressure on the globe and seem to depend on central stimulation of the vegetative nervous system as a result of afferent impulses received through the fifth nerve.

Portoghese estimated the sugar in the capillary and venous blood of eighteen normal persons before and for an hour after digital pressure on both globes, maintained for one minute. In all these persons he observed a positive oculocardiac reflex of the type considered normal. The slowing of the pulse was not over twelve beats per minute. In all cases an increase of blood sugar was noted which amounted to from 0.06 to 0.3 per cent. This occurred within from ten to twenty minutes. In a few cases a second lowering of the pulse occurred after from twenty to thirty minutes, which was accompanied by a second rise in the blood sugar. The difference between the capillary and the venous glycemia was very slight (from 0.02 to 0.09 per cent), indicating that the rise in the blood sugar was not due to an increased amount of insulin in the blood. The conclusion seemed justified that the rise in the blood sugar was due to stimulation of the sympathetic-adrenal mechanism. There was no constant relation between the degree of bradycardia and the amount of hyperglycemia. A bibliography is included.

S. R. Gifford.

The Pupil

Comparison of Suprarenin Bitartrate and Cocaine Plus Euphthalmine as Mydriatics for Elderly Patients. L. T. Post, Am. J. Ophth. **20:** 33 (Jan.) 1937.

Post reviews the work of Horner and Bettman on mydriasis from suprarenin bitartrate. He then compares the action of suprarenin bitartrate, 2 per cent, with that of cocaine, 1 per cent, plus euphthalmine,

1 per cent, the former being instilled in the left and the latter in the right eye of each of ten patients. He found that: (1) suprarenin acted faster and more powerfully, though in a small percentage of cases it did not dilate the pupil; (2) cocaine plus euphthalmine caused an increase in tension in four cases; (3) the mydriasis was much less easily controlled with physostigmine in the cases in which suprarenin was used, and in six of these pain supervened whereas there was no occurrence of pain in the cocaine-euphthalmine group. A number of incidental observations were made. Post concludes that cocaine plus euphthalmine is in general preferable as a mydriatic for ophthalmoscopic purposes in elderly patients.

W. S. REESE.

PUPILLARY ACTIVITY OF THE DIENCEPHALON AND MESENCEPHALON. E. CLAES, Compt. rend. Soc. de biol. **123:** 1009, 1936.

Confirming Magoun and Ranson's observations (*Arch. Ophth.* 13: 791 [May] 1935), Claes finds that faradic excitation of the pretectal zone (the posteromedial portion of the dorsal thalamus) induces bilateral miosis, generally with an associated downward movement of the globes and closure of the lids. Stimulation of the corpora quadrigemini, especially the posterior tubercles, causes moderate mydriasis, unmodified by section of the cervical sympathetic nerve but abolished by a cut separating the anterior from the posterior tubercles. An independent but more marked mydriatic action follows stimulation applied to the anterior cut surface of the internal capsule inferomedially. These mydriatic actions work through inhibition of the Edinger-Westphal nuclei; extreme miosis results from section of the brain stem anterior to the third nerves. The miosis of sleep is based on this mechanism.

J. E. LEBENSOHN.

Physiologic Optics

A STUDY OF TWO HUNDRED AND EIGHTY-EIGHT PATIENTS EXAMINED WITH THE OPHTHALMO-EIKONOMETER. C. BERENS, Brit. J. Ophth. **21:** 132 (March) 1937.

Berens describes the ophthalmo-eikonometer and the method of examining eyes with the instrument. The patients are classified according to age and sex; their symptoms are described, and the results obtained are tabulated. The relations of heterophoria and emmetropia to aniseikonia are considered. The following conclusions are given:

A study of 288 patients reveals no apparent significance in the age or sex of the patients for whom iseikonic lenses were prescribed. However, the percentage of females was slightly higher than that of males. A majority of the patients were between the ages of 25 and 40.

Apparently there are no pathognomonic symptoms which are complained of by patients with aniseikonia or which seem to be relieved by wearing iseikonic corrections. The most typical symptoms which seem to be relieved are asthenopia and headaches, especially when these symptoms are aggravated by reading.

In this series of cases there seems to be a tendency for the smaller image to be in the right eye and for the differences to be found more frequently in the horizontal than in the vertical meridian.

Apparently there was definite relief from symptoms in 68.7 per cent of the 160 patients who wore iseikonic lenses, and half of those who reported improvement had marked or nearly complete relief.

At present it is impossible to determine whether the factor which is measured with the ophthalmo-eikonometer and corrected by iseikonic lenses is aniseikonia alone.

Much scientific research with many hundreds of clinical experiments and careful analyses of statistics must be carried out before the exact place of aniseikonia in causing ocular symptoms can be conclusively evaluated.

W. ZENTMAYER.

Physiology

BLUE ARCS OF THE RETINA. H. PIÉRON, Compt. rend. Soc. de biol. **124:** 523, 1937.

Audubert and Levy demonstrated that emission of ultraviolet rays followed stimulation of the sciatic nerve of the frog. Hertel found the cones of the frog's retina to be directly sensitive to light rays as short as 2,260 angstrom units. Piéron consequently suggests that the blue arcs may be due to this emission. Viewing ultraviolet rays produces no phenomena, since the ocular media absorb the effective rays.

J. E. LEBENSOHN.

OPTOKINETIC ELICITATION OF VERTICAL DEVIATIONS. H. BURIAN, Arch. f. Ophth. **136:** 215 (Nov.) 1936.

Patterns consisting of black and white stripes were mounted on two drums revolving around horizontal axes. If these patterns were presented to the observer by means of the haploscope and both patterns moved in the same direction, the observer's eyes showed vertical optokinetic nystagmus. If one pattern was moving downward and the other upward, the eyes of the observer remained still. If during this procedure the observer also had to overcome a vertical prism equivalent to his vertical ductions, transient vertical diplopia resulted. These observations represent further evidence for the existence of an independent innervational complex for vertical divergence. The biologic significance of this complex lies, according to Tschermak-Seysenegg, in the functional compensation of heterophoria.

P. C. KRONFELD.

DETERMINATION OF THE PRESSURE IN THE VENAE VORTICOSAE OF NORMAL HUMAN EYES. E. SEIDEL, Arch. f. Ophth. **136:** 303 (Dec.) 1936.

The work reported in this paper represents the application of the principle of ophthalmodynamometry to the venae vorticosae. Ophthalmoscopic examination of the intra-ocular portion of these veins in albinotic but otherwise normal human eyes reveals definite narrowing of the outlets of the venous sinuses when very slight pressure is exerted on the globe. Seidel's interpretation of this phenomenon is that the pressure in these veins is, just like the pressure in the retinal veins, only very slightly higher than the intra-ocular pressure. The pressure in the choroidal capillaries can be only slightly higher (according to the author

about 30 mm. of mercury) than that in the veins and production of intra-ocular fluid by physical forces alone is impossible.

P. C. KRONFELD.

Refraction and Accommodation

"TWINCENTRIC" LENSES. F. A. WILLIAMSON-NOBLE, Brit. J. Ophth. **21:** 116 (March) 1937.

Williamson-Noble describes a bifocal lens with the center of the reading portion displaced inward to allow for convergence. It is not necessary for the centers to coincide; they need be only on the same horizontal level. The lens may be made as a solid bifocal, but so made it has the disadvantage of producing a conspicuous reading segment, the upper border of which is clearly visible and may annoy the wearer. The lens may also be made to a fused bifocal. The disadvantage of such a lens is that there is some chromatic aberration in the reading segment. This is practically abolished by making up the lens in a slight tint.

W. ZENTMAYER.

THE DEVELOPMENT OF MODERN METHODS OF ESTIMATING REFRACTION. W. B. E. MCCREA, Brit. J. Ophth. **21:** 118 (March) 1937.

This is a historical article tracing the development of lenses and refraction from antiquity up to 1870. The title of the article is misleading.

W. ZENTMAYER.

Retina and Optic Nerve

RETROBULBAR INJECTIONS OF ATROPINE IN ARTERIOSCLEROTIC ATROPHY. F. C. CORDES, Am. J. Ophth. **20:** 53 (Jan.) 1937.

Cordes briefly reviews the literature and reports a case of arteriosclerotic atrophy in which there was improvement following retrobulbar injections of atropine.

W. S. REESE.

RETINAL ANGIOSPASM IN TOXEMIA OF PREGNANCY AND HYPERTENSION. E. SELINGER, Am. J. Ophth. **20:** 56 (Jan.) 1937.

Selinger discusses spasm of the retinal arteries and emphasizes the importance of differentiating functional and organic disease ophthalmoscopically. He gives the following summary.

"Spasms of the retinal arteries may be intermittent or continuous. The presence of intermittent spasms facilitates the diagnosis and makes it more certain. Only a segment of an artery or several large branches may be affected. They are an almost constant accompaniment of toxemia of pregnancy and, together with other retinal changes are of great prognostic importance. The ophthalmologist has an opportunity to study, under great magnification, the type of vessel concerned in hypertension. A study of these vessels will help in differentiating the form of hypertension amenable to treatment from that in which treatment is hopeless.

"Eyeground changes in nephritis are largely the result of arteriolar disease rather than the nephritis per se."

W. S. REESE.

KATHOLYSIS IN THE TREATMENT OF RETINAL DETACHMENT: A PRELIMINARY NOTE. H. B. STALLARD, Brit. J. Ophth. **21:** 35 (Jan.) 1937.

Stallard describes fully the ocular ionizer he employs and describes in detail his technic in operating for retinal detachment. He gives the following conclusions and summary:

"Katholysis in the surgical treatment of retinal detachment is of value for the purpose of localizing the site of a retinal hole in relation to the external surface of the sclera at the time of operation. The cauterization produced leads to fine choroido-retinal scars which in my opinion, may be adequate for sealing small holes and for tears in the lower half of the retina but have insufficient tenacity for moderate and large holes in the upper half of the retina.

"Up to date none of the serious immediate and late post-operative complications which are seen in some cases treated by surgical diathermy have been noted after katholysis."

The article is illustrated.

W. ZENTMAYER.

THE SITUATION OF RETINAL TEARS. SCHIFF-WERTHEIMER, Ann. d'ocul. **174:** 39 (Jan.) 1937.

In the course of the necessary ophthalmoscopic examination that precedes surgical treatment in detachment of the retina, Schiff-Wertheimer has observed certain signs that have helped in the localization of the tear. These varied according to the age of the patient, on one hand, and according to the refraction of the eye, on the other.

The cases have been divided into three groups: (1) detachment of the retina in adult myopes (high or low), (2) detachment in nonmyopes past middle age and (3) detachment in children or young nonmyopic subjects.

In the first group, myopes of middle age, the tear is found in the superior part of the retina, about the vertical meridian—for example, in the right eye between 11 and 2 o'clock. In the second group, myopes of advanced age, the tear is usually found around or near the level of the horizontal meridian, most frequently at the temporal side between 8 and 10 o'clock. In the third group, nonmyopic young subjects, the visual disturbance is frequently in the superior nasal field, corresponding in a great number of cases to retinal disinsertion in the inferior temporal quadrant—for example, in the right eye between 7 and 8 o'clock.

S. H. McKEE.

SPASMS OF THE CENTRAL ARTERY OF THE RETINA. J. SEDAN and G. E. JAYLE, Ann. d'ocul. **174:** 73 (Feb.) 1937.

This article is part III, continued from the August and November numbers of the Annales, and begins with the subject of "Prolonged visual disturbance of spasmodic origin." This is subdivided into the following topics: blindness or amblyopia with the picture of embolus of the central artery or of its branches; blindness or amblyopia with the picture of simple atrophy; blindness or amblyopia from fever, and blindness or amblyopia from diverse causes.

These conditions are described in detail, the second one being subdivided again into atrophy by essential spasm, tabetic atrophy, atrophy from quinine and diverse toxemias, and hemorrhagic atrophy. Illustrative cases are described.

This study shows that the conditions described under the term "retinal spasm" may be placed in two distinct categories. In the first are found all the amblyopias or transitory blindnesses called spasmodic associated with embolus of the central artery. The second includes all the amblyopias and permanent blindnesses attributed to spasm with embolic conditions excluded. No comparison between the two groups can be made which would warrant any form of transition between the two.

The bibliography of the complete article is added.

S. H. McKee.

Angiospasm of the Retinal Arteries. L. Marucci, Ann. di ottal. e clin. ocul. **64**: 671 (Oct.) 1936.

Marucci reviews the literature on spasm of the retinal arteries, his interest being in spasm of the smaller vessels rather than in complete closure of the central artery. He reports a remarkable case which resembles some cases reported by Castelli previously abstracted in the Archives. The patient was a woman of 38 in whom visual disturbances occurred at the seventh month of lactation. During this time the patient had nursed not only her own child but another infant. She had increased rapidly in weight for several years before and had noted menstrual irregularities. The visual disturbances were ushered in with nausea, dizziness and intense pain in the left eye. After three days vision was reduced to perception of movements of the hand. On the sixth day similar disturbances began in the right eye, and after five days vision was reduced to perception of light in this eye. The blood pressure showed only a slight elevation, and microscopic examination of capillaries showed slowing of the circulation in the nail fold, with tortuosity of the vessels. Otherwise the physical findings were practically normal. Each eye showed marked edema of the disk and surrounding retina, with large tortuous veins and small arteries. There was slight improvement in vision, with ability to count fingers, following the use of acetylcholine. Nineteen days after the onset the use of an estrogenic preparation was begun, 2,000 units being injected on alternate days. Vision began to improve rapidly and after twenty days of treatment had reaced 6/10 in each eye. The treatment was stopped, and vision at once began to diminish, decreasing to ability to count fingers in each eye. Treatment with estrogen was resumed, and vision improved to 10/15 in the right eye and 10/10 in the left after thirteen days. Further improvement occurred, so that five weeks later vision was normal in each eye. The right disk was pale, with blurry borders, while the left fundus was reported as normal.

Marucci believes the condition was due to reduction in the caliber of the retinal arteries due to spasm. While the vessels were not completely occluded, their volume was reduced. The attacks of headache and vertigo seemed to indicate spasm of other vessels. The association with lactation and menstrual disturbances and the marked improvement on treatment indicate ovarian dysfunction, though other glands were probably involved.

S. R. Gifford.

DIABETIC RETINITIS: A STUDY OF ONE HUNDRED AND FIFTEEN CASES. R. BRAUN, Arch. f. Ophth. **136:** 256 (Nov.) 1936.

The paper is based on thorough clinical studies of 770 diabetic persons, 115 of whom showed retinal changes. The diabetes in the latter patients was moderately severe and of long duration. The characteristic ophthalmoscopic features of the retinitis were *absence* of edema of the retina and of disk and vascular changes. Braun believes that the retinitis in such cases is caused by the diabetic disturbance of tissue metabolism, i. e., chiefly by the acidosis and ketonemia. Vascular changes and hypertension are, contrary to the common belief, not primary. In some of the cases the retinitis seemed to be related to renal insufficiency. There is no efficacious treatment for diabetic retinitis. The author has seen no sign that insulin exerts harmful effects on the normal or on the diseased retina.

P. C. KRONFELD.

THE HEREDITY OF HYALINE BODIES OF THE DISK. M. LEIMGRUBER, Arch. f. Ophth. **136:** 364 (Dec.) 1936.

To the five known families in which several members of one or two successive generations showed hyaline bodies (drusen) of the disks Leimgruber adds five more. None of the patients revealed signs of active or healed neuritis. Some brothers or sisters of patients with definite hyaline bodies showed slightly elevated, indistinctly outlined "pseudoneuritic" disks. For these, the presence of deeply situated and therefore invisible hyaline bodies is assumed. "Hyaline bodies may be the result of neuritis or the result of an inherited tendency toward the deposition of hyalin."

P. C. KRONFELD.

OCCURRENCE AND ETIOLOGY OF DETACHMENT OF THE RETINA: REPORT OF CASES. W. MEISNER, Klin. Monatsbl. f. Augenh. **97:** 289 (Sept.) 1936.

Meisner studied 180 eyes with detachment of the retina which came to his observation at the ophthalmic clinic of the University of Cologne between 1932, the year in which operations were introduced systematically for this disease, and 1935. He attempted to divide these cases into groups, eliminating those cases from his statistics in which intra-ocular or orbital tumors were the etiologic factors, those in which the eye presented transient detachment resulting from nephritic edema or exudation and those in which the detachment was caused by isolated inflammatory choroidal foci. The occurrence of tears is given due consideration, and mention is made that in 111 eyes, or 61.7 per cent of the 180, the detachment was cured. Furthermore, the following questions are discussed: whether the duration of a detachment may be estimated and to what extent recovery and function of the fovea depend on the time which elapsed between the observation of the first symptoms and the operation. Detachment due to contusion and other injuries was found in 26 eyes, 5 of which were emmetropic, the detachment occurring at the site of the injury. Detachment followed contusion in 19 eyes,

13 of which had been otherwise damaged or were myopic. Meisner thinks that detachment in myopic persons may be caused by contusions.

The location of the tears is discussed. Meisner found the tear after injuries in the temporal half of the eyeball, contrary to Gonin's experience. Indirect lesions and concussions led to detachment in 5 eyes, 4 of which were myopic; the second eye became afflicted spontaneously in 2 patients later on. In conclusion Meisner expresses his opinion as follows: The extent of the detachment allows no estimation regarding its duration; the size of the tear and the condition of the vitreous must be taken into consideration. An interval in which the eye is free from symptoms does not preclude a connection between injury and detachment.

Myopic and aged persons are especially subject to detachment, myopic persons being affected chiefly between the ages of 30 and 50, persons of advanced age, after 50 years of age. The higher the myopia, the greater the danger. Two groups of detachment may be distinguished in emmetropic persons less than 50 years old: those with spontaneous large tears in the temporal lower portion of the ora serrata and those with so-called inflammatory detachment.

K. L. STOLL.

TREATMENT OF ATROPHY OF THE OPTIC NERVE: REPORT OF CASES. H. ARRUGA, Klin. Monatsbl. f. Augenh. **97**: 308 (Sept.) 1936.

Arruga treated a number of patients with tabetic atrophy of the optic nerve according to Lauber's therapy, which aims to increase the lowered blood pressure of these patients. Six case histories are reported, and the treatment is described. It consists of nourishing food, hypodermic injections of strychnine, caffeine, epinephrine hydrochloride, ephedrine sulfate and atropine sulfate, also sun baths and mountain climate, if possible. Vision was increased in three of the six patients and decreased in two; it remained stationary in a number of cases. Arruga made the following observations: The blood pressure of patients with tabetic atrophy of the optic nerve is generally low. Failure of vision of some of these patients may be caused by compression of the retinal capillaries in consequence of insufficient blood pressure in the intra-ocular arterial system. The course of the disease is favorably influenced by raising the general blood pressure and lowering the intra-ocular pressure. Similarly, patients with glaucoma show improvement as soon as the blood pressure rises, while they experience deterioration as soon as it decreases.

K. L. STOLL.

TREATMENT OF ATROPHY OF THE OPTIC NERVE WITH RETROBULBAR INJECTIONS OF ATROPINE SULFATE. V. I. KOSMIN, Sovet. vestnik oftal. **9**: 686, 1937.

During 1932-1934, thirty-five patients aged from 10 to 60 years, suffering from optic atrophy of various causes, were treated with retrobulbar injections of a 1:1,000 solution of atropine sulfate. The injections were given every other day, the doses being 0.03, 0.05, 0.08 and 1 cc., about ten injections being made into each orbit. No complications were observed except dryness in the mouth. The intra-ocular tension

was unchanged. The visual fields were examined before and after the injections. The time of observation was from five to twelve months; a table gives the data.

Kosmin arrived at the following conclusions:

1. Retrobulbar injections of a 0.1 per cent solution of atropine sulfate brought about improvement of vision in 73.5 per cent of the cases.

2. Injections of atropine sulfate into the retrobulbar space of one eye resulted in improvement of vision in the other, untreated eye also, in 58.3 per cent of the cases.

3. In 41 per cent of the cases, enlargement of the visual field for white was noticed.

4. The injections of atropine sulfate did not cause dilatation of the pupil.

5. The increase of visual acuity was observed usually half an hour after injection, at which time a maximal increase of the temperature in the conjunctival sac was also registered. Thus, possibly active hyperemia plays a part in the result of the injections.

6. The results were more favorable in cases of postneuritic atrophy and in those of spasm of the retinal vessels than in cases of simple atrophy.

O. SITCHEVSKA.

SEMEIOLOGIC VALUE OF CHOKED DISK WITH TUMOR OF THE BRAIN AND NEURITIS OPTICA. D. GRIGORESCU, V. BUCUR and G. CONSTANTINESCU, Spitalul **55:** 149 (April) 1935.

Mistakes are still occurring in the differential diagnosis of choked disk and papillitis. It is altogether wrong to talk about choked disk when but slight elevation of the optic papilla is present (up to 2 diopters). It is realized also that, with inflammatory optic neuritis, rather intense edema of the papilla may be present. To distinguish clearly between choked disk and inflammatory papillitis is a matter of decisive prognostic importance as well as a guide for treatment.

The authors had the opportunity of observing diagnostic errors in two patients. The first was a man 27 years of age; an oculist diagnosed choked disk. Neurologic examination disclosed no evidence of any disturbance of the central nervous system. The acuteness of vision had markedly decreased. The serum Wassermann reaction was markedly positive. The cerebrospinal fluid was normal in every respect. The patient was urged to undergo decompression craniotomy. A second oculist held the view that it was a case of typical optic neuritis. Antisyphilitic treatment was started. Two months later the pathologic changes in the optic nerve had retrogressed, but there was still slight decoloration of the papilla.

The second patient was a woman 45 years of age. She complained of headache and loss of vision. Examination revealed choked disk. The Wassermann reaction was markedly positive. The neurologic examination gave negative results. The initial diagnosis of a tumor of the brain was eliminated by the response to rigorous antisyphilitic treat

ment. The ocular symptoms vanished, and vision improved. The question arises what are the criteria arguing in favor of edema in a case of mechanical choked disk. The authors answer the question as follows: Ophthalmoscopic examination alone does not disclose much; the visual field must be examined. The initial symptoms of neuritis are intensive and rapid, subjective and functional. In the case of choked disk there is a disproportion between the pronounced objective ophthalmoscopic symptoms and the slight functional loss. In the case of choked disk the field of vision shows concentric regular contraction and coordination for white and all other colors. In the case of neuritis the narrowing is irregular and more pronounced with regard to colors. No chromatic disturbances are present in the case of choked disk, though they do exist with neuritis. The same thing holds good for disturbances in the adaptation to light. In the case of choked disk the cerebrospinal fluid is more apt to show pathologic changes. Neuritis may be cured by adequate treatment; on the other hand, improvement by means of decompression craniotomy would occur rarely in cases of choked disk.

The authors share Christensen's and Zamenhoff's opinion that the oculist must limit his examination to the fundus oculi, the field of vision and the acuteness of vision, leaving the diagnosis to the neurologist.

N. BLATT.

RETROBULBAR NEURITIS AMONG THE CHINESE: REPORT OF FIFTY-THREE CASES. C. K. LIN, Chinese M. J. **50:** 1345 (Oct.) 1936.

Retrobulbar neuritis is a disease involving the optic nerve, characterized by a selective affinity for the papillomacular fibers. Clinically it is represented by three cardinal signs: impaired vision, central scotoma and a fundus picture that shows disproportionally few or no abnormal findings to account for the loss of vision. The present knowledge of retrobulbar neuritis is still elementary. The etiology of the condition is obscure; of its pathologic features little is known, while its treatment is empirical and nonspecific in most cases.

Lin reports on the examination of fifty-three patients with this condition. The etiology was determined with a high degree of probability in twelve cases (22.6 per cent) and with some degree of probability in three cases (5.7 per cent); it remained unknown in thirty-eight cases (71.7 per cent). These figures are compared with the findings of Scheerer, Benedict, Gifford and Wilmer. The absence of multiple sclerosis and of tobacco and alcohol poisoning as causative factors in this series marked a striking difference from the findings in other countries. It is suggested that avitaminosis may play an important rôle in retrobulbar neuritis among the Chinese. The different forms of treatment are discussed; these include the administration of iodine compounds, fever therapy, sweat baths, the use of vitamins, the extraction of teeth and oral prophylaxis, and nonspecific therapy. With regard to the latter, as the condition is one with an obscure etiology and a transient course and as the patient is prone to recover spontaneously, the value of nonspecific therapy is extremely difficult to appraise. There is an extensive bibliography.

S. H. MCKEE.

Trachoma

THE RICKETTSIA OF TRACHOMA. H. FOLEY and L. PARROT, Compt. rend. Soc. de biol. **124:** 230, 1937.

The presence of rickettsioid corpuscles in trachoma was confirmed. They are identified by the authors with inclusion "elementary" bodies. Trachoma is considered a local infection with a rickettsia, and the suggestion is made that the rickettsial conjunctivitis of sheep, swimming pool conjunctivitis and inclusion blenorrhea of the new-born belong to similar bacteriologic groups.

J. E. LEBENSOHN.

HISTOPATHOLOGIC CHANGES IN TRACHOMA AND IN OTHER FOLLICULAR DISEASES OF THE CONJUNCTIVA IN CONNECTION WITH THEIR PATHOGENESIS. A. J. POKROVSKY, Sovet. vestnik oftal. **9:** 482 and 755, 1937.

This is a thorough study of the subject and is abstracted with difficulty. It occupies 84 pages and is subdivided into 22 chapters, with detailed discussion of various theories and of clinical and histopathologic data. Nineteen photomicrographs illustrate the articles. An abundant bibliography is appended. Pokrovsky comes to the following conclusions (condensed by the abstractor):

1. The conjunctiva of the human and of the animal eye is reconstructed and acquires adenoid qualities after birth. In its adenoid structure it resembles the mucous membrane of the respiratory and gastro-intestinal tracts and reacts similarly to irritation.

2. This reaction is observed mainly in the interfollicular lymphoid tissue.

3. The adenoid tissue, which is young and resembles the mesenchyme, in its reaction to irritation produces young cellular elements of lymphoid and reticulo-endothelial character.

4. The structure of the follicle of the subepithelial adenoid tissue is identical in all mucous membranes; it is unstable and may undergo identical phases of development.

5. The active phase of the embryonal center of the follicle is the result of irritation of the external medium. During this phase some new follicles form (physiologic irritation) and some die (pathologic irritation).

6. In follicular catarrh a change occurs in the details of the reaction which manifests itself in the number of follicles, in their location in relation to the epithelium, in their size, in the state of the embryonal center and in the degree of infiltration of the superficial layer of the conjunctiva.

7. In trachoma the details of the reaction are numerous and various. Outside of those mentioned, these are added: the degree of degeneration in the center of the follicle, the degree of infiltration of the interfollicular tissue and the degree of degeneration in the basal tissue of the conjunctiva.

8. However, proliferative changes with degeneration and frequent scar formation is the predominant picture in trachoma; by this it is differentiated from other conjunctival inflammatory processes.

9. The trachomatous process is not limited to the follicles. Pascheff's "laws of trachoma" are therefore one-sided and do not explain the basic process.

10. The trachomatous process is chiefly in the subepithelial adenoid layer of the conjunctiva. In severe forms the inflammation extends to the deep layers of the conjunctiva.

11. The study of the clinical material shows that the infiltrative forms predominate.

12. Neither the clinical nor the histopathologic data reveal the presence of a special hyperplastic (noninflammatory) process in trachoma.

13. The histopathologic and clinical study is of definite value, but bacteriology only will bring a final and decisive solution of the problem of the pathogenesis of trachoma.

O. SITCHEVSKA.

TRACHOMA IN CHINA. H. T. PI, Chinese M. J. **50:** 1465 (Oct.) 1936.

From writings in ancient classical books, trachoma must have existed in China at least since the time of the Emperor Huang Ti, in 2679 B. C., though no definite description of the disease has been found until 1752 A. D., in the Tang Dynasty. It was in the Ming Dynasty, in 1598 A. D., that Wang K'en Tang made accurate observations on this condition and described various clinical aspects of the disease.

It is found all over China, and at least one third of the whole population suffers from it. It is more prevalent in the north than in the south on account of the dry climate and dust storms in the northern section. Infection is spread chiefly by the wide use of common towels in public places and by the use of the same towels, wash basins and water in the household.

The complications and sequelae of trachoma are discussed. Particular emphasis is placed on the value of the early detection of mild pannus by means of the loupe and the slit lamp. The differential diagnosis of trachoma, folliculosis and vernal catarrh is discussed. The treatment of trachoma, especially the use of both surgical and medical treatment for the severe type of the disease, is outlined.

S. H. MCKEE.

Uvea

CHOROIDAL TEARS. A. HAGEDOORN, Am. J. Ophth. **20:** 13 (Jan.) 1937.

Hagedoorn briefly discusses tears of the choroid and reports the case of a 17 year old girl who was struck in the right eye with a cardboard disk. Vision was normal. Under mydriasis a slightly curved streak was visible to the temporal side of the macula, a typical "rupture of the choroid." A diagnosis of rupture of the pigmented epithelium seemed more adequate but lacked an anatomic basis. Recently an eye enucleated for glaucoma demonstrated the possibility of such a lesion, and Tillema described such a rupture situated near the ora serrata.

W. S. REESE.

FAMILIAL HYALINE DYSTROPHY IN THE FUNDUS OCULI, OR DOYNE'S FAMILY HONEYCOMB "CHOROIDITIS." M. TREE, Brit. J. Ophth. **21:** 65 (Feb.) 1937.

Tree points out the fact that many pathologic processes of diverse origin in the macular region produce an ophthalmologic picture of whitish spots in the fundus and that a particular degeneration, namely hyaline change, may be the end-result of different diseases. To Doyne is credited the first definite dissociation of a familial type of "central choroiditis" as a distinct clinical entity. A brief description of Doyne's observations and Collins' histologic report on one of the eyes in Doyne's cases is given. The author reports on seven patients with Doyne's disease whom he has repeatedly examined, giving the refraction, the visual field, the light sense, the threshold for color, the appearance of the fundus and media and the results of physical examination. Among conditions that have sometimes given rise to confusion in diagnosis and which Tree describes are Tay's nonfamilial type of choroiditis, retinitis circinata, cerebromacular degeneration, retinitis punctata albescens, early mild disseminated choroiditis, arteriosclerotic retinitis, renal choroiditis and exudative choroiditis.

The article is illustrated.

W. ZENTMAYER.

Vitreous

WARMING OF THE VITREOUS IN THE RABBIT'S EYE BY SHORT WAVES. W. KOKOTT, Klin. Monatsbl. f. Augenh. **97:** 448 (Oct.) 1936.

In the first chapter of his paper Kokott discusses the technic applied and the results obtained with short waves by Schliephake, Liebesny, de Decker and Arendt, Sattler and others. Then he describes his own method, the thermic conditions of the rabbit's eye when short waves are used and the degrees of temperature obtained in the vitreous of the rabbit's eye by short waves. He arrived at the following conclusions: Single irradiations of from five to ten minutes are borne well by the animals, but untoward action may be observed on repeated raying in short intervals of time. The increase of temperature as such appears to have no unfavorable effect. Irradiation for more than ten minutes offers no advantages. The electrodes must be closely fitted to the head of the animal to prevent burns. It is essential to limit the therapeutically active field accurately so as to prevent undesirable effects on adjoining tissues. The question whether the results following short wave irradiation are actually produced by thermic action remains unsettled.

K. L. STOLL.

Sympathetic Ophthalmia

REPORT ON TWO CASES OF SYMPATHETIC OPHTHALMIA. C. SCHWARZENBURG, Chinese M. J. **50:** 1433 (Oct.) 1936.

This paper deals with two cases of severe sympathetic ophthalmia which was cured by injections of a solution containing cinchophen sodium, sodium salicylate and procaine hydrochloride.

The first case was one of sympathetic ophthalmia of short duration accompanied by neuritis and inflammation of the central and the

peripheral part of the choroid. In the course of eight months the patient received 112 injections of the aforementioned preparation and also 6 injections of a solution of sodium salicylate and caffeine sodium salicylate in methenamine. There was not a single general reaction, and acuity of vision improved from counting fingers at 0.5 meter to normal.

In the second case, acuity of vision was reduced to counting of fingers just in front of the eye. The patient was treated for two years and received 19 injections of cylotropin and 203 injections of atophanyl. These were well tolerated, and vision returned to normal.

S. H. McKee.

Therapeutics

Prevention of Ocular Complications in Tryparsimide Therapy. M. Fine and H. Barkan, Am. J. Ophth. **20**: 45 (Jan.) 1937.

Fine and Barkan discuss the ocular dangers of tryparsamide therapy and note that in 95 per cent of the cases the unfavorable reaction occurs before the tenth injection. They therefore make a careful examination of the fields, fundi and vision before the first, third, fifth and tenth treatments and before every tenth treatment thereafter. Of 132 patients so treated, only 3 had unfavorable reactions, and these had not been properly checked as suggested here. Five other patients suffered impairment of the visual fields, which cleared up in from one to two months after cessation of the therapy. W. S. Reese.

Local Treatment of Ocular Diseases by Radium Emanation. G. Lenz, Klin. Monatsbl. f. Augenh. **97**: 216 (Aug.) 1936.

Lenz discusses in detail the physical and therapeutic phases of treatment with radium emanation. Then he describes an apparatus which permits the dispensation of any medicamentous solution. This apparatus may be used for clinical and scientific purposes if combined with an electroscope. Lenz used oils and ointments for radium emanation for over three years in doses ranging from the smallest to those of from 100 to 300 electrostatic units. Among the ocular diseases treated were diseases of the lids, blepharoconjunctivitis, scrofular conditions of the conjunctiva and cornea and corneal scars, parenchymatous keratitis, trachoma and trachomatous pannus, and degenerative processes of the corneal epithelium and adjoining layers. This therapy requires further research, yet it has yielded results that warrant the following conclusions:

1. It is indicated in chronic inflammatory diseases of the epidermis of the lids.

2. It is indicated in nonpurulent inflammatory and degenerative corneal processes running a slow course, as soon as the height of the inflammation has passed. Regeneration and clearing of the tissues were greatly furthered by the emanation therapy. The causative factor was apparently not influenced by the treatment.

3. The treatment is contraindicated in yellow purulent infiltrative and ulcerous processes of the cornea, and in all inflammatory processes as long as severe irritation of the eyeball is present. K. L. Stoll.

ULTRASHORT WAVE TREATMENT OF THE EYE. W. GUTSCH, Klin. Monatsbl. f. Augenh. **97**: 386 (Sept.) 1936.

Gutsch describes Schliephake's apparatus for the application of ultrashort waves to the eye and the essential points to be observed in its use. The apparatus has a wavelength of 6 microns and is fitted with glass electrodes. The main biologic and therapeutic response to these waves consists in immediate warming of the tissues, protracted hyperemia, cessation of pain, a marked afflux of leukocytes and increased phagocytosis in the inflamed tissues. Gutsch applied the rays from two to three times a week, beginning with an exposure of six minutes and gradually increasing the exposure to fifteen minutes.

No results were obtained in cases of corneal diseases, scleritis and glaucoma. The results were satisfactory in diseases of the fundus, ocular tuberculosis and paralyses of the ocular muscles and in purulent inflammatory processes of the lids, the tear sac and the orbit. Among those cured were seventy-eight persons with chronic iridocyclitis due to various causes or following operation; opacities of the vitreous cleared in some of them. Choroidal tubercles melted in two cases, leaving a smooth whitish scar on restitution of normal vision. Subjective improvement, which occurred sooner than usual, was noted in eighty cases of disease of the retina and choroid, in some of which the condition was acute, in others of the chronic degenerative type.

K. L. STOLL.

Society Transactions

EDITED BY DR. JOHN HERBERT WAITE

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

March 15, 1937

JOHN H. DUNNINGTON, M.D., *Chairman*

LEGRAND H. HARDY, M.D., *Secretary*

SURGICAL INTERVENTION ON THE CORNEA. DR. RAMON CASTROVIEJO.

The cases in which corneal transplants were successful which were presented before the society proved that work on the problem of corneal surgical intervention has greatly advanced and from now on it must not be considered wholly experimental. There is a great deal still to be done to improve the results in difficult cases, and when a suitable technic is found the percentage of good results will compare favorably with that obtained with surgical intervention for retinal detachment and glaucoma.

ESSENTIAL PROGRESSIVE ATROPHY OF THE IRIS. DR. HUGH S. MCKEOWN.

This article will be published in full in a later issue of the ARCHIVES.

RECOVERY FROM TOBACCO-ALCOHOL AMBLYOPIA WITH CONTINUANCE OF TOBACCO AND ALCOHOL. DR. FRANK D. CARROLL.

Alcoholic polyneuritis and the alcoholic type of pellagra are now considered to be deficiency diseases. Nutrition apparently plays an important rôle in tobacco-alcohol amblyopia. During the past two years a small series of patients with this condition were hospitalized, allowed to smoke and drink as much as they did while the amblyopia was developing and made to take a diet adequate in all respects but especially high in the vitamin B fraction. This was supplemented by brewers' yeast, vegex and wheat germ. Four sample cases in which this treatment proved successful were reviewed.

CHRONIC CATARRHAL CONJUNCTIVITIS PRODUCED BY STAPHYLOCOCCUS AUREUS. DR. PHILLIPS THYGESON.

The conjunctivitis-inducing power of staphylococci appears to depend on the production of an exotoxin. With potent toxins, conjunctivitis of varying severity can be produced in monkeys and rabbits. A close correlation between the production of toxin by staphylococci and their relationship to conjunctivitis in man is shown. The conclusion is reached

that toxin-forming staphylococci are an important cause of chronic catarrhal conjunctivitis.

ORBITAL CYSTS WITHOUT EPITHELIAL LINING. DR. JOHN M. WHEELER.

This article will be published in full, with the discussion, in a later issue of the ARCHIVES.

April 19, 1937

JOHN H. DUNNINGTON, M.D., *Chairman*

LEGRAND H. HARDY, M.D., *Secretary*

CASE OF TUBEROUS SCLEROSIS. DR. BRUCE GROVES.

Tuberous sclerosis is a heredofamilial disease associated with mental deficiency and manifested by cerebral symptoms, Pringle's nodules or other fibromas of the skin, tumors of the viscera and brain and tumors of the retina or disk arising from the nerve fiber layer. These are found singly or in conjunction. The case of a man aged 43 with epilepsy and retinal tumor was reported as an example of this condition.

DISCUSSION

DR. DAVID WEXLER: Tuberous sclerosis and neurofibromatosis of Recklinghausen are closely allied, and symptoms of each may coexist in the same patient. In 1930 Dr. I. Goldstein and I described the case of a young woman with pigmented neurofibromas of the skin, a fibrosarcoma of the scapula and a distinctly low mentality. Unfortunately the fundi were not seen, owing to infiltration of the corneas. At autopsy careful examination failed to reveal lesions in the brain. Many melanotic nodules in the iris and melanosis of the choroid and sclera were observed. Since this report was published (ARCH. OPHTH. 3: 288 [March] 1930) these eyes have been carefully reviewed, and numerous small irregular flat and pedunculated growths were noted on the surface of the retina. They consisted of groups of fine, fibrillar, poorly differentiated glial tissue which pierced the membrane limitans interna. An occasional nucleus was seen.

INDUCED HYPERPYREXIA IN OPHTHALMOLOGY. DR. S. ARCHARD MORRIS.

A group of 16 persons with various ophthalmic conditions were treated with general physical hyperpyrexia in addition to the established local measures. Physical therapy appears to be of value in the ocular complications of gonorrhea, in iritis, in superficial punctate keratitis and in scleritis. It appears to offer little or no aid in trachoma, syphilitic uveitis and interstitial keratitis.

RECENT ADVANCES IN THE BACTERIOLOGY OF MOOREN'S ULCER. DR. ISADORE GIVNER.

A case of Mooren's ulcer was presented, in which there was a low phytotoxic index of Pels and Macht, suggesting a systemic toxin. Bacteriologic studies gave negative results. A demonstration of the gram-negative bacillus of Rodigina isolated from a patient with Mooren's ulcer in 1934 was given, together with the report of studies on its properties as shown on cultures and in experiments.

DISCUSSION

DR. RUDOLF AEBLI: As Dr. Givner stated, the ulcer progressed after it was cauterized with trichloro-acetic acid. Then covered with a conjunctival flap, it seemed to be held in check for three or four weeks, after which it again began to spread. A Gifford delimiting keratotomy was then performed, and the wound was kept open daily for ten days. It is interesting to speculate about what cured the ulcer. Was the cure due to the production of an epithelial barrier, which shut off the advancing margin, or was it due to the production of prolonged hypotony?

PHYSIOLOGY OF THE RETINAL CIRCULATION. DR. FRITZ BLOCH.

A new method of mapping the avascular area of the macula by means of Purkinje's figures produced by the retinal vessels was shown. With Bailliart's method the pressure in the retinal vessels of healthy persons was studied, and an average arterial pressure of 60 mm. of mercury systolic and 30 mm. diastolic was found. There was no measurable difference between the pressure in the right eye and that in the left eye. The capillary pressure was about 25 mm. of mercury, and the venous pressure nearly equaled the intra-ocular pressure.

DISEASES OF THE RETINAL BLOOD VESSELS. DR. ERVIN TUSAK.

The diseases of the retinal blood vessels were enumerated. The pathogenesis and pathologic changes in the tissue in blood vessels of various kinds and calibers were discussed. Emphasis was laid on the importance of arteriolosclerosis, an effect of hypertension. The diseases of distant organs which may affect the retinal blood vessels were reviewed.

DISCUSSION

DR. S. A. AGATSTON: I wish to disagree with the speaker's statement about diabetes. He insists that diabetic retinitis is really caused by angiospastic disease, yet from my clinical studies I feel sure that is not so. One sees cases of advanced malignant hypertension in which the retinal vessels show no exudate and no hemorrhage, as Dr. Tusak himself showed. The arteries may be occluded and may be replaced by strands of connective tissue, yet there may be no hemorrhage and no exudative process. There are cases of essential hypertension in which the retinal vessels show marked signs of angiospasm and practically no hemorrhage. On the other hand, one sees the same picture of essential hypertension and the same arteriolar condition in a patient with hyperglycemia, and the hemorrhagic process is likely to appear. And one

may find diabetic patients with practically normal arteries and without hypertension, yet the patient may show a marked hemorrhagic process. I feel, therefore, that diabetes may cause retinitis because of a change in the composition of the blood, possibly due to a change in the osmotic pressure within the capillaries or to altered permeability of the capillaries. Furthermore, one sees hemorrhages in young diabetic patients who have no arteriosclerosis.

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OPHTHALMOLOGY

March 18, 1937

CHARLES R. HEED, M.D., *Chairman*

ALEXANDER G. FEWELL, M.D., *Clerk*

LIGHT ADAPTATION AT THE MACULA: AN EXAMPLE OF ITS INDUSTRIAL IMPORTANCE. DR. EDMUND B. SPAETH.

This article will be published in full in a later issue of the ARCHIVES.

PATHOLOGIC CHANGES IN THE FILTRATION ANGLE IN SIMPLE GLAUCOMA. DR. PERCE DELONG.

This brief paper reviews the pathologic processes and changes in the filtration angle.

THEORY AND PRACTICE OF TONOMETRY. DR. JONAS S. FRIEDENWALD.

Tonometric measurement is not a direct measurement of the intra-ocular pressure but is a measurement of the degree of indentation of the cornea produced by the tonometric plunger with a given load. As was noted by the earliest writers on tonometry, this measurement is not a record of the intra-ocular pressure alone, but is influenced by other factors, of which the distensibility of the eyeball as a whole is the most important, since indentation of the cornea with no net loss of the intra-ocular fluid must be associated with stretching of the ocular coats elsewhere. If one compares two eyes which have the same intra-ocular pressure but which differ markedly in the rigidity or distensibility of their coats, one will erroneously conclude from the tonometric reading that the pressure in the more rigid eye is higher than that in the more distensible eye. The present study represents an attempt to disentangle these two factors in the tonometric reading.

A study of the experimental data reported by others on the distensibility of the eyeball leads to the calculation of a simple mathematical relation between the volume and the pressure in any given eye, from which a coefficient of rigidity can be determined. If the eye could be distended by two different amounts and the pressure determined at these two different degrees of distention, the coefficient of rigidity of the eye could be determined. The studies which Schiötz undertook in calibrat-

ing his tonometer enable one to calculate the volume of corneal indentation corresponding to any given reading on the scale of the tonometer, i. e., the volume by which the eyeball is distended and the actual pressure in the eye carrying the tonometer. By making tonometric readings with two different weights one is able to determine the coefficient of rigidity of any eye and to arrive at a correct estimate of the intra-ocular pressure.

The results of this analysis indicate the following: 1. There is a systematic error in the Schiötz scale. The intra-ocular pressure is actually somewhat higher than the Schiötz scale indicates, a finding which is in agreement with the new comparisons of tonometric and manometric measurements that have been made on living eyes. (A corrected Schiötz scale for eyes of average rigidity is given.) 2. Clinically significant readings of the ocular rigidity can be made. 3. The rigidity of the eye increases with age, and its measurement is influenced by the axial refraction, the corneal curvature and certain drugs. In glaucoma, after a prolonged period of high tension the rigidity is abnormally high, but in glaucoma in which the tension is controlled the rigidity is normal. The rigidity of the eyeball is, therefore, an effect of glaucoma rather than a cause. In extreme myopia the rigidity of the eye is abnormally high, indicating that the coats of the eye have been stretched beyond their limit of elasticity.

DISCUSSION

DR. FRANCIS HEED ADLER: Did I understand Dr. Friedenwald to say that the smaller the eyeball the greater the rigidity of the coats, and that this is a general rule, with one exception, namely, in high myopia, in which the globe is excessively large yet has an extremely high degree of rigidity?

DR. ALFRED COWAN: Do you not think that the increased rigidity in very high myopia is probably due to the same cause as that found in uveitis?

DR. JONAS S. FRIEDENWALD: Since the relation of the change in the intra-ocular pressure to a measured change in the intra-ocular volume has been chosen as the coefficient of rigidity, it is to be expected that small eyes, though they may be perfectly normal, will show a higher coefficient of rigidity than large eyes. The same measured change in volume is proportionately greater in the case of the former than in that of the latter. For instance, the coefficient of rigidity, as determined from the experiments of Clark, previously referred to, is greater in monkeys than in cats and greater in cats than in dogs, as is to be expected from the difference in the size of the eyeballs of these different species. One would anticipate, therefore, that hyperopic eyes and eyes with a small radius of corneal curvature would have a higher coefficient of rigidity than myopic eyes and eyes with a large radius of corneal curvature. This relationship was found to hold as predicted, except in the case of extreme myopia, in which the distensibility of the eyeball is less than the large size of the eyeball would lead one to predict. The cause of this relative increase in the rigidity of the eyeball in extreme myopia has not been ascertained. I have suggested a possibility that the sclera in these cases has been stretched beyond its elastic limit, but other explanations may be advanced which are at least equally reasonable.

Book Reviews

Tenth Annual Report of the Giza Memorial Ophthalmic Laboratory, Cairo, 1935. Price, 25 piasters. Pp. 136, with illustrations. Cairo: Schindler's Press, 1936.

The tenth annual report records the administration and scientific work of the laboratory during 1935 under the following four headings:

I. *Postgraduate Education.*—The usual postgraduate course in medical and surgical ophthalmology was given during April and October. Twenty candidates for admission to the ophthalmic section of the department of public health attended the course given in April and fourteen the course given in May.

II. *Pathologic Section.*—Five hundred and twenty-eight pathologic specimens and 16,064 smears from the eyes of patients with purulent ophthalmia were submitted for examination. Among the 139 blind eyes received, the sight in 89, or 64 per cent, had been destroyed through acute ophthalmia. Among the interesting specimens studied were 1 showing xeroderma pigmentosum, 2 showing uveal tuberculosis, 1 showing involvement of the eyelid with an infection due to filaria Bancrofti, 2 showing neurofibroma and 1 showing a true neuroma believed to have arisen from the sympathetic ganglions of the lacrimal gland. There were 5 cases of "fly-blown orbit" due to infestation with the eggs or larvae of Wohlfahrtia magnifica.

The statement is made that from 60 to 70 per cent of epithelial scrapings from the conjunctiva of patients attending the Government Ophthalmic Hospital, Giza, show eosinophils or eosinophilic granules. The presence of a fine tenacious pellucid membrane which can be stripped from the conjunctiva is considered to be of much greater diagnostic value in spring catarrh than eosinophilia.

III. *Clinical Section.*—Among the interesting conditions observed at the laboratory during the year were gangrene of the left upper eyelid; tuberculous abscess of the cornea; subconjunctival dislocation of the lens; a peculiar form of cataract associated with glaucoma; asteroid hyalitis, and familial cerebromacular degeneration. There are short descriptions of the clinical features of each case reported and many representative photographs and colored drawings.

IV. *A. Pathologic and Bacteriologic Research.*—The etiology of trachoma is still the major research problem of the laboratory, but no account of the work in progress for 1935 is included in the report. Dr. R. P. Wilson, the director of the laboratory, has continued his study of the seasonal incidence of acute ophthalmia and has made observations in different parts of Egypt under varying conditions of temperature and humidity. In Egypt the principal causes of infectious conjunctivitis are the gonococcus, the Koch-Weeks bacillus and the diplobacillus of Morax and Axenfeld. The diplobacillus appears to have no true seasonal variation, but Koch-Weeks conjunctivitis and gonococcic conjunctivitis habitually become epidemic during the spring and fall.

A study of the twenty-seven specimens showing sympathetic ophthalmia received by the laboratory during the past fifteen years was made by Dr. Ibrahim A. Mohamed, the assistant pathologist. The outstanding findings of the study were: (1) the high proportion of cases in which an operation was the original trauma and (2) the large number of cases in which there was no trauma.

B. Clinical and Therapeutic Research.—The experimental work carried out during the past few years at the village of Bahtim, near Cairo, was continued. It was found impossible to prevent trachoma and acute ophthalmia by means of prophylactic drops, such as zinc sulfate, acriflavine hydrochloride and silver nitrate.

Therapeutic tests were made with a number of proprietary preparations submitted for use in trachoma. None was found to have an advantage over copper sulfate and crude chaulmoogra oil, the remedies commonly employed. A fever-producing preparation was found to compare favorably with milk in the treatment of gonorrheal ophthalmia.

The annual report closes with two appendixes, "The Various Forms of Conjunctivitis Among Children in Egypt and the Near East," by R. P. Wilson, and "Tebeprotin in Diagnosis and Treatment," by Ibrahim A. Mohamed.

PHILLIPS THYGESON.

Atlas der Augenkrankheiten. By Prof. Rudolf Thiel, Frankfort-on-Main. Price, 24 marks. Pp. 196, with 420 illustrations, mostly in color. Leipzig: Georg Thieme, 1937.

Starting with the premise that one remembers what one sees better than what one hears, the author has written a textbook on ophthalmology which consists mainly of illustrations with a brief explanatory text. In the text will be found a description of the important symptoms, etiology and treatment of diseases of the eye. The arrangement of the subject matter is not the usual one but is the one easiest to follow in teaching; thus, the anatomic and pathologic features and the operative treatment, if any is indicated, are given for each clinical condition. The illustrations are principally photographs, but drawings are used when details are necessary. The pictures of the fundus are drawings in color.

A study of the book quickly shows that it admirably fulfils its purpose, and the author is to be congratulated. The illustrations are excellent, and those in color, particularly, show up well. The student or practitioner will find a vast number of conditions admirably described. A possible adverse criticism might be that the text is too brief, particularly as regards the outline of treatment and operative procedure, but it is to be remembered that this is primarily an atlas and hence is to be used only in conjunction with a textbook. Finally, mention should be made of the remarkable reasonableness of the price of the book; here is an atlas with four hundred and twenty illustrations, mostly in color, which sells for 24 marks.

ARNOLD KNAPP.

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

Honorary President: Prof. F. de Lapersonne, 217 Fauborg St. Honoré, Paris.
President: Dr. P. Bailliart, 66, Boulevard Saint-Michel, Paris (6e).
Secretary-General: Prof. M. Van Duyse, Université de Gand, Gand, Prov. Ostflandern, Belgium.
All correspondence should be addressed to the President, Dr. P. Bailliart.

International Ophthalmologic Congress

Secretary: Dr. E. Marx, Costzeedijk 316 Rotterdam, Holland.
Place: Cairo. Time: Dec. 8-14, 1937.

International Organization Against Trachoma

President: Dr. A. F. MacCallan, 33, Welbeck St., London, W., England.

FOREIGN

British Medical Association, Section on Ophthalmology

President: Dr. P. E. H. Adams, 6, Holywell, Oxford.
Secretary: Dr. Thomasina Belt, 13, Mitchell Ave., Jesmond, Newcastle-on-Tyne.

Chinese Ophthalmological Society of Peiping

President: Dr. H. T. Pi, Peiping Union Medical College, Peiping.
Secretary: Dr. C. K. Lin, 180 Hsi-Lo-yen, Chienmeng, Peiping.
Place: Peiping Union Medical College, Peiping. Time: Last Friday of each month.

German Ophthalmological Society

President: Prof. Lohlein, Jena.
Secretary: Prof. A. Wagenmann, Heidelberg.

Midland Ophthalmological Society

President: Dr. T. E. Ashdown Carr, 34, Charnwood St., Derby, England.
Secretary: T. Harrison Butler, 81 Edmund St., Birmingham, England.
Place: Birmingham and Midland Eye Hospital.
Time: Oct. 1, 1937.

Ophthalmological Society of Egypt

President: Prof. Dr. Sayed Abdel Hamid Soliman Pasha, Faculty of Medicine, Cairo.
Secretary: Dr. Abdel Fattah El Tobgy, 3, Midan Soliman Pasha, Cairo.
Time: March 1938.

Ophthalmological Society of the United Kingdom

President: Mr. Gordon M. Holmes, 9, Wimpole St., London, W. 1.
Secretary: Mr. J. D. M. Cardell, 27, Weymouth St., London, W. 1.

Ophthalmology Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Road, Bombay 4.
Secretary: Dr. H. D. Dastur, Dadar, Bombay 14.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

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* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

OXFORD OPHTHALMOLOGICAL CONGRESS

Master: Dr. C. G. Russ Wood, Hill House, Abberbury Rd., Iffley, Oxford, England.
Hon. Secretary-Treasurer: Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury, England.
Time: July 8-10, 1937.

POLISH OPHTHALMOLOGICAL SOCIETY

President: Dr. W. Kapuściński, 2 Waly Batorego, Poznań.
Secretary: Dr. J. Sobański, Lindley'a 4, Warszawa.
Place: Lindley'a 4, Warszawa.

ROYAL SOCIETY OF MEDICINE, SECTION OF OPHTHALMOLOGY

President: Dr. Ransom Pickard, 31, East Southernhay, Exeter, England.
Secretary: Dr. A. Rugg-Gunn, 35 Harley St., London, W. 1.

SOCIÉTÉ FRANÇAISE D'OPHTALMOLOGIE

Secretary: Dr. René Onfray, 6 avenue de la Motte Picquet, Paris 7è.

SOCIETY OF SWEDISH OPHTHALMOLOGISTS

President: Prof. F. Berg, Uppsala, Sweden.
Secretary: Dr. K. O. Granström, Södermalmstorg 4 III tr., Stockholm, Sö., Sweden.

TSINAN OPHTHALMOLOGICAL SOCIETY

Chairman: Dr. Eugene Chan, Cheeloo University School of Medicine, Tsinan, Shantung.
Place: Cheeloo University School of Medicine. Time: Last Thursday of alternate months.

NATIONAL

AMERICAN MEDICAL ASSOCIATION, SCIENTIFIC ASSEMBLY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Secretary: Dr. Derrick T. Vail Jr., 441 Vine St., Cincinnati.
Place: San Francisco. Time: June 13-17, 1938.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY, SECTION ON OPHTHALMOLOGY

President: Dr. Lee W. Dean, Washington University Medical School, St. Louis.
Executive Secretary-Treasurer: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: Palmer House, Chicago. Time: Oct. 10-15, 1937.

AMERICAN OPHTHALMOLOGICAL SOCIETY

President: Dr. Frederick H. Verhoeff, 243 Charles St., Boston.
Secretary-Treasurer: Dr. Eugene M. Blake, 303 Whitney Ave., New Haven, Conn.
Place: Hot Springs, Va.

NATIONAL SOCIETY FOR THE PREVENTION OF BLINDNESS

President: Mr. William Fellowes Morgan, 50 W. 50th St., New York.
Managing Director: Mr. Lewis H. Carris, 50 W. 50th St., New York.

SECTIONAL

CENTRAL WISCONSIN SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. E. S. Schmidt, 107 E. Walnut St., Green Bay.
Secretary: Dr. G. L. McCormick, 626 S. Central Ave., Marshfield.

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

President: Dr. James J. Regan, 520 Commonwealth Ave., Boston.
Secretary-Treasurer: Dr. William P. Beetham, 5 Bay State Road, Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

PACIFIC COAST OTO-OPHTHALMOLOGICAL SOCIETY

President: Dr. A. J. Ridges, Walker Bldg., Salt Lake City, Utah.
Secretary-Treasurer: Dr. Frederick C. Cordes, 384 Post St., San Francisco.
Place: Salt Lake City, Utah. Time: May 24-27, 1937.

PUGET SOUND ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. L. H. Klemptner, 509 Olive St., Seattle.
Secretary-Treasurer: Dr. Purman Dorman, Virginia Mason Hospital, Seattle.

ROCK RIVER VALLEY EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Frank Brodrick, 302 First Ave., Sterling, Ill.
Secretary-Treasurer: Dr. Thorsten E. Blomberg, Swedish-American Bank Bldg., Rockford, Ill.
Place: Rockford, Ill., Janesville or Beloit, Wis. Time: Third Tuesday of each month.

SAGINAW VALLEY ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Robert Griswell, 707 Washington Ave., Bay City, Mich.
Secretary-Treasurer: Dr. W. K. Slack, 308 Eddy Bldg., Saginaw, Mich.
Place: Saginaw, Mich., or Bay City, Mich. Time: Second Tuesday of each month, except July and August.

SIOUX VALLEY EYE AND EAR ACADEMY

President: Dr. L. H. Hohf, Yankton, S. D.
Secretary-Treasurer: Dr. J. C. Decker, Francis Bldg., Sioux City, Iowa.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. William A. Wagner, 914 American Bank Bldg., New Orleans.
Secretary: Dr. O. M. Marchman, Medical Arts Bldg., Dallas, Texas.

SOUTHWESTERN MICHIGAN TRIOLOGICAL SOCIETY

President: Dr. O. B. McGillicuddy, 1908 Capitol Band Tower, Lansing, Mich.
Secretary-Treasurer: Dr. Maurice C. Loree, 120 W. Hillsdale St., Lansing, Mich.
Time: Third Thursday of alternate months.

WESTERN PENNSYLVANIA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. C. W. Beals, Weber Bldg., DuBois.
Secretary-Treasurer: Dr. C. W. Beals, Weber Bldg., DuBois.

STATE

COLORADO OPHTHALMOLOGICAL SOCIETY

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Edna M. Reynolds, 227 16th St., Denver.
Place: Capitol Life Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. Walter L. Hogan, 750 Main St., Hartford.
Secretary-Treasurer: Dr. Shirley H. Baron, 309 State St., New London.
Time: May, November.

Eye, Ear, Nose and Throat Club of Georgia

President: Dr. B. H. Minchew, 701 Elizabeth St., Waycross, Ga.
Secretary-Treasurer: Dr. Edward S. Wright, 1001 Medical Arts Bldg., Atlanta, Ga.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. J. R. Dillinger, French Lick.
Secretary: Dr. Frederick V. Overman, 705 Hume-Mansure Bldg., Indianapolis.

Iowa Academy of Ophthalmology and Oto-Laryngology

President: Dr. James A. Downing, 406 Sixth Ave., Des Moines.
Secretary-Treasurer: Dr. O. L. Thorburn, 213½ Main St., Ames.
Place: Des Moines.

Louisiana-Mississippi Ophthalmological and Otolaryngological Society

President: Dr. C. A. McWilliams, G. and S. I. R. R. Bldg., Gulfport, Miss.
Secretary-Treasurer: Dr. Edley H. Jones, 1301 Washington St., Vicksburg, Miss.

Michigan State Medical Society, Section of Ophthalmology and Otolaryngology

Chairman: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Secretary: Dr. D. R. Heetderks, 26 Sheldon Ave., S. E., Grand Rapids.

Minnesota Academy of Ophthalmology and Oto-Laryngology

President: Dr. William L. Benedict, Mayo Clinic, Rochester, Minn.
Secretary-Treasurer: Dr. Walter E. Camp, 1918 Medical Arts Bldg., Minneapolis.
Time: Second Friday of each month from October to May.

Montana Academy of Oto-Ophthalmology

President: Dr. Edward S. Murphy, Northern Pacific Hospital, Missoula.
Secretary: Dr. A. W. Morse, 507 Phoenix Bldg., Butte.

New Jersey State Medical Society, Section on Ophthalmology, Otology and Rhinolaryngology

Chairman: Dr. C. Coulter Charlton, 124 S. Illinois Ave., Atlantic City.
Secretary: Dr. H. L. Harley, 124 S. Indiana Ave., Atlantic City.

New York State Medical Society, Eye, Ear, Nose and Throat Section

Chairman: Dr. Walter S. Atkinson, 168 Sterling St., Watertown.
Secretary: Dr. Marvin F. Jones, 121 E. 60th St., New York City.

North Carolina Eye, Ear, Nose and Throat Society

President: Dr. J. M. Lilly, 302 Old St., Fayetteville.
Secretary-Treasurer: Dr. Frank C. Smith, 106 W. 7th St., Charlotte.
Place: Charlotte. Time: October.

North Dakota Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. Rosenberger, 221 Fifth St., Bismarck.
Secretary-Treasurer: Dr. F. L. Wicks, 514 Sixth St., Valley City.

Oregon Academy of Ophthalmology and Oto-Laryngology

President: Dr. A. B. Dykman, Medical Dental Bldg., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

Acting President: Dr. Nathan Bolotow, 108 Waterman St., Providence.
Secretary-Treasurer: Dr. Gordon J. McCurdy, 122 Waterman St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. R. E. Houston, 103 E. North St., Greenville.
Secretary: Dr. J. W. Jervey Jr., 101 Church St., Greenville.

TENNESSEE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. W. W. Potter, 601 Walnut St., Knoxville.
Secretary-Treasurer: Dr. W. D. Stinson, 248 Madison Ave., Memphis.

TEXAS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. T. E. Fuller, 100 W. Board St., Texarkana, Texas.
Secretary: Dr. O. M. Marchman, 1719 Pacific Ave., Dallas.
Place: Fort Worth. Time: Dec. 11 and 12, 1937.

UTAH OPHTHALMOLOGICAL SOCIETY

President: Dr. V. P. White, 143½ S. Main St., Salt Lake City.
Secretary-Treasurer: Dr. E. B. Fairbanks, Boston Bldg., Salt Lake City.
Time: Third Monday of each month.

VIRGINIA SOCIETY OF OTO-LARYNGOLOGY AND OPHTHALMOLOGY

President: Dr. Edwin W. Burton, University of Virginia, University.
Secretary-Treasurer: Dr. George G. Hankins, 202 Medical Arts Bldg., Newport News.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. F. O. Marple, First Huntington National Bank Bldg., Huntington.
Secretary: Dr. J. E. Blaydes, First National Bank, Bluefield.

LOCAL

ACADEMY OF MEDICINE OF NORTHERN NEW JERSEY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. Samuel T. Hubbard, 294 State St., Hackensack, N. J.
Secretary: Dr. William F. McKim, 488 Sanford Ave., Newark, N. J.
Place: 91 Lincoln Park South, Newark. Time: 8:45 p. m., second Monday of each month, October to May.

AKRON ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. L. E. Brown, Second National Bldg., Akron.
Secretary-Treasurer: Dr. C. R. Andersen, First-Central Tower, Akron.
Time: First Monday in January, March, May and November.

ATLANTA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. William C. Warren Jr., 478 Peachtree St., Atlanta, Ga.
Secretary: Dr. Alton V. Hallum, 478 Peachtree St., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St. Time: Second Friday of each month from October to May.

BALTIMORE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Jesse W. Downey Jr., 529 N. Charles St., Baltimore.
Secretary: Dr. Mary L. Small, 18 W. Read St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

Brooklyn Ophthalmological Society

President: Dr. Walter V. Moore, 1 Nevins St., Brooklyn.
Secretary-Treasurer: Dr. Mortimer A. Lasky, 1 Nevins St., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. Thurber LeWin, 112 Linwood Ave., Buffalo.
Secretary-Treasurer: Dr. Meyer H. Riwchun, 367 Linwood Ave., Buffalo.
Time: Second Thursday of each month.

Chattanooga Society of Ophthalmology and Otolaryngology

President: Each member, in alphabetical order.
Secretary: Dr. A. H. Benz, 706 Medical Arts Bldg., Chattanooga.
Place: Mountain City Club. Time: Second Thursday of each month from September to May.

Chicago Ophthalmological Society

President: Dr. G. Henry Mundt, 30 N. Michigan Ave., Chicago.
Secretary-Treasurer: Dr. Earle B. Fowler, 55 E. Washington St., Chicago.
Place: Medinah Michigan Avenue Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cincinnati Ophthalmic Club

Chairman: Each member, in rotation.
Secretary-Treasurer: Dr. E. R. Thomas, 819 Carew Tower, Cincinnati.
Place: Holmes Memorial Library, Cincinnati General Hospital. Time: 8:15 p. m., third Monday of each month except June, July and August.

Cleveland Academy of Medicine, Section of Ophthalmology and Otolaryngology

Chairman: Dr. A. D. Ruedemann, 2020 E. 93d St., Cleveland.
Secretary: Dr. Fred W. Dixon, 1029 Rose Bldg., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Cleveland Ophthalmological Club

Chairman: Dr. A. B. Bruner, 629 Euclid Ave., Cleveland.
Secretary: Dr. M. W. Jacoby, Hanna Bldg., Cleveland.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. Charles R. Heed, 1205 Spruce St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

Columbus Ophthalmological and Oto-Laryngological Society

Chairman: Dr. Andrew Timberman, 21 E. State St., Columbus, Ohio.
Secretary-Treasurer: Dr. Claude S. Perry, 40 S. Third St., Columbus, Ohio.
Place: Deshler Wallick Hotel. Time: 6 p. m., first Monday of each month.

Corpus Christi Eye, Ear, Nose and Throat Society

Chairman: Dr. A. W. Davidson, City National Bank Bldg., Corpus Christi, Texas.
Secretary: Dr. E. King Gill, 720 Medical-Professional Bldg., Corpus Christi, Texas.
Time: Second Thursday of each month from October to May.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. Hugh L. McLaurin, 1719 Pacific Ave., Dallas, Texas.
Secretary: Dr. Maxwell Thomas, 1719 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Des Moines Academy of Ophthalmology and Otolaryngology

President: Dr. E. G. Linn, 604 Locust St., Des Moines, Iowa.
Secretary-Treasurer: Dr. Grace Doane, 614 Bankers Trust Bldg., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month from September to May.

Detroit Ophthalmological Club

Chairman: Members rotate alphabetically.
Secretary: Dr. William Fowler, 1424 Maccabee Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. A. W. Greene, 148 Barrett St., Schenectady.
Secretary-Treasurer: Dr. Joseph L. Holohan, 317 State St., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. Van D. Rathgeber, 1012 Medical Arts Bldg., Fort Worth.
Secretary-Treasurer: Dr. Charles R. Lees, 306 W. Broadway, Fort Worth.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

Grand Rapids Eye, Ear, Nose and Throat Society

President: Dr. Dewey R. Heetderks, 405 Medical Arts Bldg., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Robert G. Laird, 500 Metz Bldg., Grand Rapids, Mich.
Place: Various local hospitals. Time: Third Thursday of alternating months, September to May.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. Henry C. Haden, 1914 Travis St., Houston, Texas.
Secretary: Dr. George C. Farrish, 1625 Main St., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

Indianapolis Ophthalmological and Otolaryngological Society

President: Dr. J. C. Daniel, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

Kansas City Society of Ophthalmology and Oto-Laryngology

President: Dr. H. B. Davis, 1101 Grand Ave., Kansas City, Mo.
Secretary: Dr. Byron Black, Professional Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

Long Beach, Eye, Ear, Nose and Throat Society

Chairman: Dr. K. C. Brandenburg, 110 Pine Ave., Long Beach, Calif.
Secretary-Treasurer: Dr. Ben K. Parks, 619 Professional Bldg., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

Los Angeles Society of Ophthalmology and Oto-Laryngology

President: Dr. Isaac H. Jones, 1930 Wilshire Blvd., Los Angeles.
Secretary-Treasurer: Dr. John P. Lordan, 2007 Wilshire Blvd., Los Angeles.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd. Time: 6:30 p. m., fourth Monday of each month from September to May, inclusive.

Louisville Eye, Ear, Nose and Throat Society

President: Dr. J. S. Bumgardner, Heyburn Bldg., Louisville, Ky.
Secretary-Treasurer: Dr. Max Bornstein, Heyburn Bldg., Louisville, Ky.
Place: Brown Hotel. Time: 6:30 p. m., second Thursday of each month from September to May, inclusive.

Medical Society of the District of Columbia, Section of Ophthalmology and Otolaryngology

Chairman: Dr. Arthur M. Zinkham, 815 Connecticut Ave., Washington.
Secretary: Dr. E. J. Cummings, 1835 I St., N. W., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

Memphis Society of Ophthalmology and Otolaryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Hychener, 130 Madison Ave., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Milwaukee Oto-Ophthalmic Society

President: Dr. Thomas A. Judge, 735 N. Water St., Milwaukee.
Secretary-Treasurer: Dr. John B. Hitz, 208 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., second Tuesday of each month.

Minneapolis Ophthalmological Society

Chairman: Each member, in alphabetical order.
Secretary: Dr. M. C. Pfunder, 645 Medical Arts Bldg., Minneapolis.
Place: Hennepin County Medical Society rooms. Time: 6:30 p. m., fourth Monday of each month, October to May, inclusive.

Montgomery County Medical Society

Chairman: Dr. A. G. Farmer, 1040 Fidelity Bldg., Dayton, O.
Secretary-Treasurer: Dr. Rome M. Webster, 663 Reibold Bldg., Dayton, O.
Place: Van Cleve Hotel. Time: 6:30 p. m., bimonthly, first Tuesday from October to June, inclusive.

Montreal Ophthalmological Society

President: Dr. Stuart Ramsay, 1496 Mountain St., Montreal, Canada.
Secretary: Dr. J. Rosenbaum, 1396 St. Catherine St., W., Montreal, Canada.
Time: Second Thursday of October, December, February and April.

NASHVILLE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. H. C. Smith, Medical Arts Bldg., Nashville, Tenn.
Secretary-Treasurer: Dr. Fowler Hollabaugh, Doctors Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to May.

NEW ORLEANS OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President: Dr. R. H. Fisher, Chess and Checker Club, New Orleans.
Secretary-Treasurer: Dr. H. F. Brewster, 837 Gravier St., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

Chairman: Dr. John H. Dunnington, 30 W. 59th St., New York.
Secretary: Dr. LeGrand H. Hardy, 30 E. 40th St., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

OMAHA AND COUNCIL BLUFFS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. W. H. Stokes, 107 S. 17th St., Omaha.
Secretary-Treasurer: Dr. Delbert K. Judd, 1020 Medical Arts Bldg., Omaha.
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m., dinner; 7 p. m., program; third Wednesday of each month from October to May.

PASSAIC-BERGEN OPHTHALMOLOGICAL CLUB

President: Dr. John S. Van Winkle, 297 Broadway, Paterson, N. J.
Secretary-Treasurer: Dr. T. A. Sanfacon, 340 Park Ave., Paterson, N. J.
Place: Paterson Eye and Ear Infirmary. Time: 9 p. m., last Friday of every month, except June, July and August.

PHILADELPHIA COUNTY MEDICAL SOCIETY, EYE SECTION

Chairman: Dr. Sidney L. Olsho, 235 S. 15th St., Philadelphia.
Secretary: Dr. Edmund B. Spaeth, 1930 Chestnut St., Philadelphia.
Time: First Thursday of each month from October to May.

PITTSBURGH OPHTHALMOLOGICAL SOCIETY

President: Dr. Glendon E. Curry, Westinghouse Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

PITTSBURGH SLIT LAMP SOCIETY

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Falk Clinic. Time: 4 p. m., second Friday of every month, except June, July, August and September.

RICHMOND OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. A. F. Bagby, Professional Bldg., Richmond, Va.
Secretary: Dr. Richard W. Vaughan, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

President: Dr. R. E. Elliott, 78 S. Fitzhugh St., Rochester, N. Y.
Secretary-Treasurer: Dr. Raphael Farber, 280 Monroe Ave., Rochester, N. Y.
Place: Rochester Medical Association, 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ophthalmic Society

President: Dr. Lawrence T. Post, 508 N. Grand Blvd., St. Louis.
Secretary: Dr. Leslie Charles Drews, 508 N. Grand Blvd., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. Oscar H. Judkins, 414 Navarro St., San Antonio, Texas.
Secretary-Treasurer: Dr. Wilfred E. Muldoon, 414 Navarro St., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Joseph W. Crawford, 490 Post St., San Francisco.
Secretary: Dr. Russell Fletcher, 490 Post St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco. Time: Fourth Tuesday of every month except May, June, July and December.

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. John T. Crebbin, 624 Travis St., Shreveport, La.
Secretary-Treasurer: Dr. J. A. Wilkinson, Medical Arts Bldg., Shreveport, La.
Place: 1240 Texas Ave. Time: 7:30 p. m., first Monday of every month except July, August and September.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. C. A. Veasey Jr., 407 Riverside Ave., Spokane, Wash.
Secretary: Dr. Philip B. Green, Old National Bank Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. W. J. Werfelman Jr., 725 State Tower Bldg., Syracuse, N. Y.
Secretary-Treasurer: Dr. I. Herbert Katz, 212 Medical Arts Bldg., Syracuse, N. Y.
Place: University Club. Time: First Tuesday of each month except June, July and August.

Toronto Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Samuel Mortimer Lyon, 122 Bloor St., W., Toronto.
Time: First Monday of each month, November to April.

Washington, D. C., Ophthalmological Society

President: Dr. James M. Greear Jr., 1740 M St., N. W., Washington, D. C.
Secretary-Treasurer: Dr. Ernest Sheppard, 927 17th St., Washington, D. C.
Place: Episcopal Eye, Ear and Throat Hospital. Time: 8 p. m., first Monday in November, January, March and May.